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A MONOGRAPH OF MALVASTRUM, II¹
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TAXONOMIC TREATMENT

The species of *Malvastrum* are distinguished by means of unique combinations of diagnostic morphic and karyological characters that vary within prescribed limits. Each species is thought to consist of potentially or actually interbreeding populations with a definable common ancestor, the majority of whose characters are retained by each population. The species presented in this treatment are not known to intergrade (no indisputable natural hybrids have been seen) and so seem to be reproductively isolated. This isolation is most evident from the fact that some species occur in the same geographic area without hybridization. Changes in chromosome number, particularly differences in ploidal level, have been a major cause of speciation through reproductive isolation.

The subspecies within a given species of *Malvastrum* have been distinguished from species by their lack of potential crossing-barriers, by a conformity in the majority of their morphological characters, and by their geographic integrity. In areas of contact between subspecies, a very few intermediate individuals may occur. In the greenhouse, the subspecies that were grown were successfully crossed and produced viable seed. Each subspecies possesses a unique set of diagnostic characters, fewer in number than those distinguishing species, that reflects a period of geographic isolation and ecological adaptation in its history. Characters such as

¹This is the second of three parts. Part I, containing the introduction and the general discussion of the genus, was published in Vol. 84, No. 837 (Jan., 1982). Part III, concluding the Taxonomic Treatment and including the Literature Cited and the Appendices, will appear in Vol. 84, No. 839 (July, 1982).

flowering and fruiting behavior, as well as morphic characters are generally very important at the subspecies level in the genus.

Varieties have been distinguished in two cases in which the morphological variant is sympatric with the typical variety. Naming these as new varieties will facilitate information retrieval for these significantly different individuals. They are defined by one or more easily distinguishable characters that are not found in the typical members of the population. Since the sympatric nature of the individuals obscures their evolutionary history, they have been relegated to the position of morphological variants within an interbreeding population rather than subspecies. The varietal category is useful in analyses of total population variation and allows one to refer to distinctive individuals within that population.

The taxa in this treatment have been arranged in approximately the same order presented in Fig. 18 and are numbered in the key and text in accordance with the OTU code presented in Appendix II. Morphological terms have, for the most part, followed the definitions in Radford et al. (1974). Measurements listed are based upon the total variation observed in both living and preserved specimens. The extremes are included within parentheses.

GENERIC DESCRIPTION

Malvastrum A. Gray, Mem. Amer. Acad. Arts n.s. 4: 2, in adn. 1849.

TYPE: *Malvastrum wrightii* A. Gray [= *M. aurantiacum* (Scheele) Walpers]. *Sidopsis* Rydberg, Fl. Prairie Plains Centr. N. Amer. 541. 1932.

Suffrutescent or herbaceous perennials or annuals (0.2) 0.5–2 (3) m tall with one to several ascending or erect fibrous to soft-woody *primary stems* 1–15 mm in diam at base, monopodially branched but usually sparingly so, branch apices green and herbaceous; *vesture* of vegetative parts with closely appressed or tufted, occasionally tuberculate or pustular-based, (2) 4–12-rayed stellate hairs, or, less frequently, sub-lepidote or simple hairs 0.05–2 mm diam; *cotyledons* ovate, subcordate truncate to wide-cuneate at the base and retuse to rounded at the apex, entire or rarely the blade obscurely 3-lobed, (6) 7–18 mm long $\times$ (7) 8–13 mm wide, petioles 3–9 mm long; *stipules* appressed or reflexed, wide-lanceolate, narrowly triangular to linear, usually falcate, long-acuminate to

subulate, (2) 3–9 (16) mm long $\times$ 0.2–1.5 mm wide, drying early and caducous or persistent, appressed-pubescent or strigose at least on the abaxial surface, the margin entire to irregularly toothed and often ciliate, with 1–5 parallel veins; *petioles* (3) 10–80 (100) mm long and 1/6 as long to subequal in length to the blade; *blades* (1.1) 2.5–6.0 (11.5) cm long $\times$ (0.3) 1.0–4.0 (10.0) cm wide, wide-ovate to lanceolate and occasionally obscurely 3-lobed, cordate truncate to wide-cuneate at the base, acute acuminate to rounded at the apex, sparsely to densely pubescent on both surfaces, margins crenate-dentate to dentate-serrate or denticulate with 2–7 teeth/cm, palmate veins 3–7 with one a pronounced midvein, conspicuously raised below and somewhat impressed above; *flowers* axillary and solitary or in terminal racemes, congested terminal spikes, or in leafless glomerate axillary spicate racemes in the upper half of the plant, pedicellate to nearly sessile, pedicels 0.1–5 (10) mm long, subtended by leaves and/or stipules or a bifid bract derived from stipules, usually open for only a few hours; *involucl* of 3 bracteoles, 2–18 mm long $\times$ 0.2–5 mm wide, distinct, appressed, and free or adnate basally to the calyx, half as long as or subequal to the calyx, deltate-cordiform to lanceolate or linear, pubescent, occasionally ciliate; *calyx* in bud often strongly 5-angled, usually densely pubescent, 2.8–15 mm measured from pedicel to lobe-apex at anthesis, somewhat accrescent in fruit, sepals united 1/5 to 3/5 their length, lobes (1.5) 4–12 mm long $\times$ (1.5) 4–7 (12) mm wide in flower and fruit and deltoid to narrowly triangular, acute, acuminate to subcuspidate at the apex, erect, spreading, or incurved in fruit, internal lobe surface with minute arachnoid hairs, with 3–5 (10) subparallel veins/lobe; *nectaries* 5, indistinct, consisting of zones of glandular hairs on the calyx below the petal-claws; *petals* 5 (rarely 6), 2.0–23 mm long $\times$ 1.5–15 mm wide and infrequently subequal to the calyx-lobes or exceeding them by as much as 8 mm, distinct, yellow or yellow-orange to pale orange, asymmetrically obovate and usually emarginate or unequally cleft, imbricate in bud with a basal non-auriculate yellow or rarely red claw 0.5–2 mm long with ciliate or bearded margins, corolla campanulate, wide-campanulate, or rotate at anthesis, rarely cleistogamous, confluent with the staminal column at the base producing an “ovary cup”; *androecium* with (5) 16–50 (111) 5-ranked or unranked monadelphous stamens, column shorter than the petals and matching them in color, the dorsifixed extrorse terminal anthers with valves oriented 180° after dehiscence,

the single locule partially divided by an incomplete septum, free portion of the filaments 0.5–1.0 mm long, filament-tube 1–7 mm in height, sparsely to moderately pubescent or glabrous; *gynoecium* with a single glabrous style branching halfway from its base into 5–18 branches equal in number to the carpels; *stigmas* terminal, subglobose, hemispherical, or unexpanded, generally papillate, yellow or rarely magenta; *carpels* in a single discoid whorl attached by their proximal margins to a central apically expanded columella, subtended by a thin carpocrater; *ovules* one in each carpel, ascending, attached to the columella below the carpel notch; *fruit* an oblate or discoid schizocarp 3–11 mm in diameter (including ornamentation), exposed or enclosed by the calyx, green or bright rose-red drying to pale, tan reddish brown to dark brown at maturity, readily or tardily shed from the shrunken columella and calyx at maturity; *mericarps* 5–18, completely to partially dehiscent or indehiscent, free from one another, laterally compressed and wedge-shaped with angular or rounded margins, 1.0–6 mm tall $\times$ 1.0–6 mm long $\times$ 0.8–2.0 mm wide including ornamentation, sparsely to densely pubescent on the apical, apical-distal, and lateral surfaces near the margins with simple and/or stellate hairs, rarely glabrous, with a conspicuous proximal notch, lateral faces smooth to radially ribbed, thin and chartaceous to leathery or firm and woody, the apical-distal-basal surface with or without a raised medial line, unornamented or more frequently with one to three apical mucros or cusps 0.1–2.3 mm long that are vertically cleft or entire, rarely the distal margins prolonged into short wings, internal surface smooth, lustrous, and glabrous, with or without a small intrusive proximal-apical endoglossum; *seeds* solitary in each mericarp, 1.0–2.5 mm long $\times$ 1–3.0 mm in height $\times$ 0.6–1.5 mm wide, ascending, incompletely filling the chamber at maturity, somewhat asymmetrically reniform or rarely narrowly elongated, glabrous, with a thick gray red-brown or black seed-coat, with or without a medial distal-apical sulcus; *chromosome-number*: $x = 6$, $2n = 12, 18, 24, 48$; *pollen* spheroidal to oblate, (36) 60–90 (108) μm in diameter, echinate with spines (2.3) 4–7 (10) μm , operculate and panporate with (4) 6–15 (35) apertures.

DISTRIBUTION.

Central United States south through Central America and the Caribbean to San Juan, Córdoba, and Buenos Aires, Argentina.

Widely introduced in the Old World Tropics especially in coastal regions, especially common in India and Australia, and probably indigenous in the latter.

KEY TO TAXA OF MALVASTRUM

1. Mericarps unornamented or with 1 proximal-apical mucro < 0.2 mm long..... (2)
2. Mericarps completely dehiscent into 2 valves with rounded margins; flowers solitary axillary; all leaves narrowly lanceolate, at least 3 times longer than wide; central United States (Section *Sidopsis*) 1. *M. hispidum*
2. Mericarps not separating into 2 valves, with angled margins; flowers in mature plants in terminal spikes or congested axillary spicate racemes; leaves ovate, sometimes narrower at branch apices, usually 1–2 times longer than wide; widespread (3)
3. Apical surface of mericarp with stellate hairs only; lateral faces of pericarp thin and fragile; flowers in leafless axillary and/or terminal congested spicate racemes < 3 cm long at maturity; Argentina and Bolivia (Section *Interruptum*) (4)
4. Mericarps 7–10, 1.0–1.5 mm in height $\times$ 1.0–1.5 mm in length $\times$ 1.4 mm in width, stamens 5–7 2. *M. spiciflorum*
4. Mericarps 10–12, 1.9–2.0 mm in height $\times$ 2.0–2.2 mm in length $\times$ 0.8–1.0 mm in width, stamens 20–27 ... 3. *M. interruptum*
3. Apical surface of mericarp with some simple hairs; lateral faces of pericarp firm; flowers in basally leafy terminal racemes or spikes commonly > 3 cm long at maturity; widespread (5)
5. Vesture of vegetative parts of 3–5-rayed appressed stellate hairs; inflorescence of solitary axillary flowers or a congested or loose terminal spike 1–2 cm long or infrequently longer; mostly Caribbean (Section *Corchorifolium*) 14. *M. corchorifolium*
5. Vesture of vegetative parts of 5–12-rayed, often tufted stellate hairs; inflorescence a raceme or terminal spike usually > 3 cm long; widespread (Section *Americanum*) (6)

6. Mericarps 7–8, the simple hairs of the apical surface confined to the proximal portion, the pericarp indehiscent; northern Queensland, Australia
..... 5. *M. chillagoense*
6. Mericarps 9–18, the apical surface rather densely pubescent throughout with simple or both simple and stellate hairs, pericarp usually incompletely dehiscent along basal-medial line; widespread (7)
7. Apical surface of mericarp with erect and appressed simple hairs only; bracteoles subequal to the calyx in flower; widespread
..... 4a. *M. americanum* var. *americanum*
7. Apical surface of mericarp with two zones of hairs: distal zone composed of appressed 5–10-rayed stellate hairs and proximal zone of erect simple hairs; bracteoles exceeding the calyx lobes in flower; eastern Australia
..... 4b. *M. americanum* var. *stellatum*
1. Mericarps with 1–3 cusps >0.2 mm long (8)
8. Apical mucro of mericarp if present set at the proximal margin; filament-tube pubescent; vesture of the stems of 4–8-rayed radially symmetric hairs; Western Hemisphere (9)
9. Distal pericarp margins never winged; mericarps 9–13, bifid floral bracts often present; inflorescence usually racemose (Section *Tomentosum*) (10)
10. Mericarp with a proximal-apical mucro or cusp 0.1–1 mm long, total height 2–3 mm, pericarp dehiscent at the proximal-apical margin; bracteoles linear, free from the calyx; South America (11)
11. Distal cusps of mericarp 0.8–2 mm long, proximal cusp 0.1–0.5 mm long; calyx lobes patent in fruit; lateral faces of pericarp usually strongly ribbed, the vesture of the apical surface of symmetrical stellate hairs; seeds with a distal-apical sulcus; Brazil, Ecuador, Peru, Venezuela
..... 6a. *M. tomentosum* subsp. *tomentosum*
11. Distal cusps of mericarp 0.3–0.7 mm long, proximal cusp 0.05–0.3 mm long; calyx lobes incurved or slightly spreading in fruit; lateral faces of pericarp smooth except for a few basal ribs, the vesture of

- the apical surface of asymmetrical stellate hairs or a mixture of simple and stellate hairs; seeds without a sulcus; Ecuador, Peru (12)
12. Vesture of apical surface of mericarp of asymmetrical stellate hairs, the lateral surface pubescent distally; petals 6–7 mm long and 3–5 mm wide; bifid floral bracts absent; Prov. Azuay, Ecuador
..... 6b. *M. tomentosum* subsp. *pautense*
12. Vesture of apical surface of mericarp of simple hairs with a few minute stellate hairs, the lateral surfaces glabrous; petals 10–13 mm long and 9–10 mm wide; bifid floral bracts usually present; northern Peru 7. *M. scoparioides*
10. Mericarp lacking a proximal apical cusp or with a mucro <0.1 mm long, total height 1.8–2.0 mm, pericarp indehiscent at the proximal-apical margin; bracteoles lanceolate, adnate to the calyx basally for 1–3 mm; Arizona to Nicaragua (13)
13. (10) Distal margins of lateral surfaces of mericarp with dense brushlike simple hairs; stem vesture of 2–6-rayed stellate hairs mixed with minute erect simple hairs; Guatemala, Honduras, Nicaragua 8. *M. guatemalense*
13. Distal margins of lateral surfaces of mericarp glabrous or sparsely pubescent; stem vesture of 4–8-rayed stellate hairs; Arizona to Oaxaca, Mexico .. (14)
14. Mericarp woody, dull, apical surface densely pubescent; lateral faces of pericarp ribbed; Arizona, northwestern and central Mexico .. (15)
15. Distal cusps of mericarp 0.5–1.5 mm long; lateral faces of pericarp distinctly ribbed; calyx-lobes patent in fruit, external surface sparsely pubescent; mericarps exposed; stigmas exserted 1.0–1.5 mm beyond anther cluster; Arizona and northern Mexico
.. 9a. *M. bicuspidatum* subsp. *bicuspidatum*
15. Distal cusps of mericarp 0.1–1 mm long; lateral faces of pericarp scarcely ribbed; calyx-lobes slightly spreading in fruit, external surface

- densely pubescent; mericarps enclosed by the calyx; stigmas exerted <1.0 mm beyond anther cluster; central high plateau of Mexico
 9b. *M. bicuspidatum*
 subsp. *campanulatum*.
14. Mericarp leathery or chitinous, somewhat lustrous, apical surface sparsely pubescent or glabrous; lateral faces of pericarp smooth or inconspicuously ribbed toward margins; central and southern Mexico (16)
16. Mericarp not plump, the apical surface with stellate hairs <0.5 mm long; endoglossum present; petals 10–14 mm long; leaves paler beneath; Oaxaca, Puebla
 ... 9c. *M. bicuspidatum* subsp. *oaxacanam*
16. Mericarp plump, the apical surface with a few erect simple or 2–3-rayed stellate hairs 0.5–1 mm long or glabrous; endoglossum absent; petals 7–10 mm long; leaves concolorous; Jalisco to Morelos (17)
17. Mericarps pubescent .. 9d. *M. bicuspidatum*
 subsp. *tumidum* var. *tumidum*
17. Mericarps glabrous
 9e. *M. bicuspidatum*
 subsp. *tumidum* var. *glabrum*
9. Distal pericarp margins briefly winged; mericarps 11–18, bifid floral bracts absent; flowers solitary, axillary (Section *Amblyphyllum*) (18)
18. Petals 17–23 mm long $\times$ 12–15 mm wide, exceeding the calyx by 4–5 mm; stigmas exceeding the anthers by 3 mm; leaf blades acute to acuminate; Bolivia
 10. *M. grandiflorum*
18. Petals 6–12 mm long $\times$ 3.5–4.5 mm wide, exceeding the calyx by 2 mm; stigmas subequal to anthers; leaf-blades obtuse; Bolivia, Paraguay, Argentina
 11. *M. amblyphyllum*
8. Apical mucro or cusp of mericarp set halfway between the proximal and distal margins; filament-tube glabrous or less frequently sparsely pubescent; vesture of the

- stems of sub-lepidote 6–10-rayed or appressed 2–4-rayed stellate hairs occasionally mixed with simple hairs, the 4-rayed hairs distinctly bilateral; widespread (19)
19. Endoglossum present but rudimentary; stamen column sparsely pubescent; cusps on mature carpels usually <0.2 mm long; bifid floral bracts present (Section *Corchorifolium*) 14. *M. corchorifolium*
19. Endoglossum absent; stamen column glabrous; cusps on mature carpels >0.2 mm long; bifid floral bracts usually absent (Section *Malvastrum*) (20)
20. Vesture of vegetative parts of sub-lepidote 6–10-rayed stellate hairs usually with basally united rays; mericarp with a prominent medial-apical cusp 1.5–2.3 mm long and 2 contiguous flattened obtuse cusps at the distal margin; Texas, U.S.A. ..12. *M. aurantiacum*
20. Vesture of vegetative parts composed of simple or 2–4-rayed bilateral stellate hairs; mericarp with a prominent or small medial-apical cusp 0.2–1.2 mm long and 2 divergent pointed cusps at the distal margin; widespread (21)
21. Mericarps 1.5–2.0 mm in height $\times$ 2.0 mm in length including ornamentation; proximal cusp 0.2–0.4 mm long and distal-apical cusps 0.1–0.2 mm long; bifid floral bracts often present; south-central Brazil
..... 13c. *M. coromandelianum* subsp. *fryxellii*
21. Mericarps 2.4–4.5 mm in height $\times$ 3–4 mm in length including ornamentation; proximal cusp 1.0–2.0 mm long and distal-apical cusps 0.3–1 mm long; bifid bracts absent; widespread (22)
22. (21) Annual or perennial herb generally with several main stems 0.2–1 m tall in age; flowers solitary axillary, somewhat apically congested in age; vesture of upper leaf surface usually of simple hairs, less frequently of stellate hairs; widespread 13a. *M. coromandelianum*
subsp. *coromandelianum*
22. Mostly perennial herbs with single main stem 0.3–

1.5 m tall in age; flowers in congested, glomerate axillary racemes ca. 1 cm long; vestiture of upper leaf surface of bilateral 4-rayed stellate hairs; Argentina, Bolivia, Galápagos
 13b. *M. coromandelianum*
 subsp. *capitato-spicatum*

Summary of taxa of *Malvastrum* A. Gray
(numbers correspond to text)

Malvastrum sect. *Sidopsis* (Rydberg) S. R. Hill

1. *Malvastrum hispidum* (Pursh) Hochreutner

Malvastrum sect. *Interruptum* S. R. Hill

2. *Malvastrum spiciflorum* (E. Hassler) A. Krapovickas

3. *Malvastrum interruptum* K. Schumann in Martius

Malvastrum sect. *Americanum* S. R. Hill

- 4a. *Malvastrum americanum* (Linnaeus) Torrey in Emory
var. *americanum*

- 4b. *Malvastrum americanum* var. *stellatum* S. R. Hill

- 5.
- Malvastrum chillagoense*
- K. Domin

Malvastrum sect. *Tomentosum* S. R. Hill

- 6a. *Malvastrum tomentosum* (Linnaeus) S. R. Hill
subsp. *tomentosum*

- 6b. *Malvastrum tomentosum* subsp. *pautense* S. R. Hill

- 7.
- Malvastrum scoparioides*
- E. Ulbrich

- 8.
- Malvastrum guatemalense*
- Standley & Steyermark

- 9a. *Malvastrum bicuspidatum* (S. Watson) Rose subsp. *bicuspidatum*

- 9b. *Malvastrum bicuspidatum* subsp. *campanulatum* S. R. Hill

- 9c. *Malvastrum bicuspidatum* subsp. *oaxacantum* S. R. Hill

- 9d. *Malvastrum bicuspidatum* subsp. *tumidum* S. R. Hill
var. *tumidum*

- 9e. *Malvastrum bicuspidatum* subsp. *tumidum* var. *glabrum* S. R. Hill

Malvastrum sect. *Amblyphyllum* S. R. Hill

10. *Malvastrum grandiflorum* A. Krapovickas

11. *Malvastrum amblyphyllum* R. E. Fries

Malvastrum sect. *Malvastrum*, emend. S. R. Hill

- 12.
- Malvastrum aurantiacum*
- (Scheele) Walpers

- 13a. *Malvastrum coromandelianum* (Linnaeus) Garcke
subsp. *coromandelianum*

- 13b. *Malvastrum coromandelianum* subsp. *capitato-spicatum*
(O. Kuntze) S. R. Hill
- 13c. *Malvastrum coromandelianum* subsp. *fryxellii* S. R. Hill
Malvastrum sect. *Corchorifolium* S. R. Hill
14. *Malvastrum corchorifolium* (Desrousseaux in Lamarck)
Britton ex Small

TREATMENT OF INDIVIDUAL TAXA

Section 1. *Sidopsis*

Malvastrum sectio **Sidopsis** (Rydberg) S. R. Hill, comb. et stat. nov.

Sidopsis Rydberg, Fl. Pr. Pl. Cent. N. Amer.: 541. 1932, pro genere. TYPE species: *S. hispida* (Pursh) Rydberg [= *Malvastrum hispidum* (Pursh) Hochreutiner].

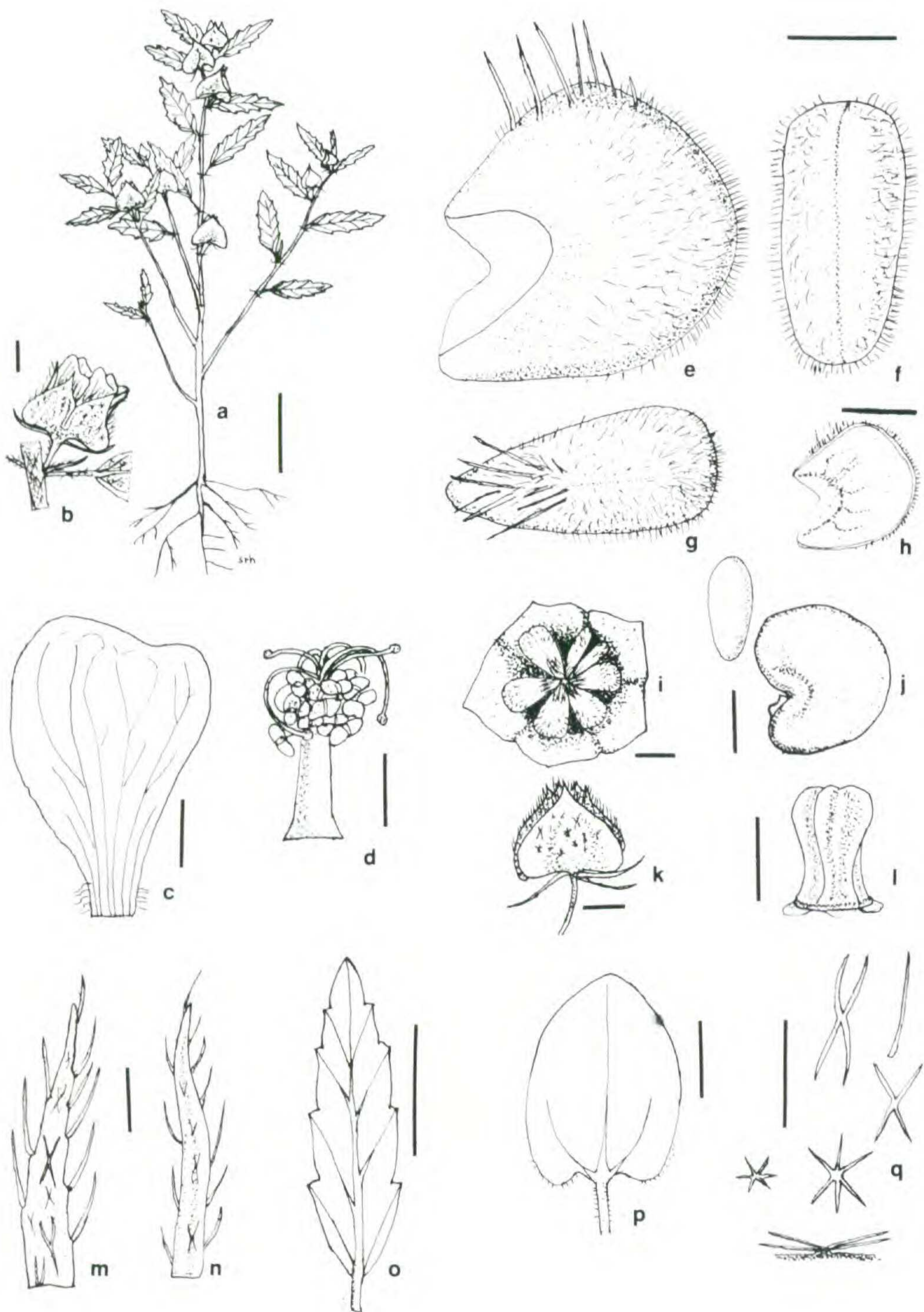
The solitary axillary occasionally cleistogamous flowers, completely dehiscent thin-walled unornamented mericarps (follicules), lack of an endoglossum and bifid floral bracts, glabrous filament tube, and 11–15 aperturate pollen characterize the section *Sidopsis*.

1. **Malvastrum hispidum** (Pursh) Hochreutiner, Annuaire Conserv. Jard. Bot. Genève 20: 129. 1917. Fig. 19.

Sida hispida Pursh, Fl. Amer. Sept.: 452. 1814. TYPE: "In sandy plains of Georgia. Lyon", apparently not preserved. Bates (1967a, p. 25) chose Pursh's description as the lectotype. *Malveopsis hispida* (Pursh) O. Kuntze, Rev. Gen. 1: 72. 1891. *Sidopsis hispida* (Pursh) Rydberg, Fl. Pr. Pl. Centr. N. Am.: 541. 1932.

Malvastrum angustum A. Gray, Mem. Amer. Acad. Arts ser. 2, 4: 22, in adn. 1849. TYPE: Missouri: St. Louis, 1832. *Drummond s.n.* (LECTOTYPE: GH; ISOTYPES: BM, K) chosen by Bates (1967a, p. 26). *Malva perpusilla* Nuttall ex A. Gray, Mem. Amer. Acad. Arts. ser. 2, 4: 22, in adn. 1849, nomen nudum, pro syn. A manuscript name on a specimen collected near the Red River, *Nuttall s.n.* (NY!). *Sphaeralcea angusta* (A. Gray) Fernald, Rhodora 41: 435. 1939.

Bushy-branched herbaceous annual (5) 25–45 (60) cm tall; *main stem* 1–3.5 mm diam at base; *branches* (7) 15–20 (30) cm long towards the main stem base and gradually reduced above; *vesture* of overlapping 4 (6)-rayed bilateral appressed, usually tuberculate-based, stellate hairs (0.5) 0.9–1.2 (2.2) mm diam longitudinal to the axis, scarcely or tardily shed in age; *cotyledons* 7 mm long × 6 mm wide, petiole 4 mm long, ovate, cordate at the base and rounded to



slightly retuse at the apex; *stipules* (2) 3–5 (7) mm long $\times$ 0.2–0.3 (0.5) mm wide, linear to linear-lanceolate to narrowly subulate; *petioles* (3) 5–10 (13) mm long; *blades* 3.1–3.9 (5) $\times$ longer than the petioles, (15) 25–35 (55) mm long $\times$ (3) 5–9 (15) mm wide and not conspicuously reduced above, lanceolate to linear-lanceolate and unlobed, base narrowly rounded to nearly cuneate, apex acute to briefly cuspidate, margins sparsely serrate-dentate with 2–2.5 teeth/cm, average midstem blade (2.8) 3.1–3.6 (8.3) $\times$ longer than wide, vestiture of the adaxial surface of scattered appressed non-overlapping (2) 4 (6)-rayed slightly bilateral hairs (0.2) 0.5–0.8 (1.1) mm diam directed towards the vein apices, often reduced to small simple hairs at the margins, vestiture of the abaxial surface of similar (4) 6 (8)-rayed appressed hairs; *flowers* solitary in axils of upper main stem and branch leaves and stipules, infrequently in 2–3-flowered reduced branches near the apex; bifid *floral bracts* lacking; *pedicels* 2–4 (10, rarely to 20) mm long in flower increasing to 5–8 (17, rarely to 25) mm in fruit; *involucel* of 3 narrowly lanceolate to linear or subfalcate bracteoles (2.6) 4–6.8 mm long $\times$ 0.3–0.6 mm wide free of the calyx or less frequently adnate in the basal 0.5–1.0 mm; *calyx* united $2/5$ to $1/2$ its length, (2.8) 5–7.2 mm from pedicel to lobe apex in flower increasing to (6) 8–10 (12.5) mm in fruit, broadly campanulate and distinctly plicate-angular due to the prolonged reniform-auriculate lobe bases, lobes (1.5) 4–5 mm long $\times$ (2) 4–5 mm wide at anthesis increasing to 7–10 mm $\times$ 7–10 (12) mm in fruit, abaxial vestiture of overlapping 4–6-rayed stellate hairs 0.3–1.5 mm diam and with simple or 2-rayed marginal hairs 0.8–1.1 mm long, adaxial surface of lobes minutely puberulent with minute arachnoid hairs; *corolla* yellow to pale yellow-orange, petals asymmetrically obovate and briefly lobed, (2.8) 3.5–4.5 mm long $\times$

Figure 19. *Malvastrum hispidum*. a. Habit, scale = 5 cm. b. Flower, scale = 2 mm. c. Petal, scale = 1 mm. d. Stamens, styles, and stigmas, scale = 1 mm. e–g. Mericarp, lateral, distal, and apical views, scale = 1 mm. h. Mericarp valve, internal surface, scale = 2 mm. i. Fruit, apical view, scale = 2 mm. j. Seed, apical and lateral views, scale = 1 mm. k. Calyx in fruit, lateral views, scale = 5 mm. l. Columella, lateral view, carpocrater nearly absent, scale = 1 mm. m. Stipule, abaxial surface, scale = 1 mm. n. Bracteole, abaxial surface, scale = 1 mm. o. Leaf, abaxial surface, scale = 1 cm. p. Cotyledon, scale = 2 mm. q. Hair types, leaf and stem, scale = 1 mm. (a,n,o,q from Bates 2686; b–d from Eggert 1282; e–h,j,l from Horr & Franklin E180; i. from Palmer 66567; k,m from Bates 2705; p from Rodin s.n.).



Figure 20. Distribution of *Malvastrum hispidum*.

(1.5) 2.5–3.5 mm wide, campanulate or unexpanded, subequal to the calyx or exceeding it by 0.5–1.0 mm, claws ciliate with few (3–5) simple hairs 0.4 mm long; *androecium* with 8–13 (16) stamens, filament tube (1.0) 1.4–1.6 mm long, glabrous, free portion of filaments 0.2–0.5 mm long; *gynoecium* with 5–6 carpels, style branching 1.5 mm above the columella, each branch terminated by an expanded globose papillose stigma recurved into the anther cluster before and after anthesis; *schizocarps* (5.6) 7–8 mm diam; *mericarps* (follicules) 5–6, (2.6) 3.0–3.5 mm in height $\times$ (2.6) 3.0–3.5 mm in length $\times$ 1.5 mm in width, separate at maturity, unornamented, margins rounded and lateral surfaces unribbed, apical-

distal-basal surface with a medial line, pubescent nearly throughout with minute simple hairs 0.1 mm long perpendicular to the pericarp surface and elongated flexible erect simple hairs 0.2–1.0 mm long restricted to the proximal-apical surface, pericarp thin and somewhat hyaline to chartaceous throughout, completely dehiscent loculicidally at maturity and separating into two valves, endoglossum lacking; *seeds* 2.1–2.5 mm in height $\times$ 2.0–2.5 mm in length $\times$ 1.3–1.5 mm in width; *chromosome number* : $n = 18$; *pollen* 56–79 (60) μm diam, *echinae* 3.6–3.8 μm , *apertures* 11–15, usually 12.

DISTRIBUTION. (Fig. 20) Temperate North America, central portion of the United States from Illinois and Iowa in the north (also reported from Nebraska), to Arkansas and Oklahoma in the south (reported in Tallapoosa Co., Alabama), east to Kentucky and Tennessee, and west to Kansas, with its greatest frequency in Missouri, at an altitude of 150–500 m, occurring in full sun or partial shade in the vicinity of limestone outcrops, rocky prairies, and alluvial soils.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering from early August through to late September, infrequently as early as mid-June and July. Plants transplanted from Missouri (Hill 4533) confirmed Bates' observations (1967a) that the flowers open in the late morning and early afternoon for a brief period (11 AM – 2 PM local time) or often do not open at all, and so are functionally cleistogamous. The anthers dehisce before the flowers open and the stigmas are covered with pollen as the petals expand. Therefore the fruits seem to be nearly if not always produced by autogamy. Flower emasculation was not attempted. No pollinators are known.

The plants and fruits mature rather rapidly and the entire life cycle is often completed in three months, perhaps as an adaptation to the temperate environment.

DISCUSSION. I have chosen to follow Bates (1967a) in retaining this species in *Malvastrum*. While a case can be made for its retention in the monotypic genus *Sidopsis* because of its completely dehiscent mericarps, the genus would differ from *Malvastrum* only by the single character. Its diagnostic characters, particularly its chromosome number, coincide with those diagnostic characters in the other species of *Malvastrum*, but the problem remains that the species has no close relatives in the genus. Most of the character states that separate *M. hispidum* from the other species, e.g. the small flowers, annual habit, and disjunct range, are viewed as derived.

Specimens annotated *Sida hispida* Pursh from Georgia have been located at OXF and PH, part of the Beyrich Herbarium. The script is not Pursh's and Lyon is not cited. However, since these are the only specimens known bearing this name, and since they are actually *Sida carpinifolia* L. f. there is still some doubt in my mind that the name has been correctly applied.

Except to a limited extent in leaf width, there is little variation discernible within the species. The small population sizes and autogamous reproduction have further limited any influx of new variation into the gene pool.

REPRESENTATIVE SPECIMENS: **United States.** ARKANSAS, Boone Co., Harrison, *Palmer 6910* (GH, US); ILLINOIS, La Salle Co., Rock Island, *Parry s.n.* (BH, BKL, BUF, F, UC, US, VT); KANSAS, Bourbon Co., *Bates 2702* (BH, GH); 7 mi S of Uniontown, *Horr & Franklin E180* (SMU, US); Geary Co., NE corner of county, *Gates 17506* (F); Jewell Co., near Lovewell, *Tolstead 41996* (UC); Ness Co., prairie, *Hitchcock 44a* (GH, US); Osborne Co., Osborne, *Popenoe s.n.* (US); Pottawatomie Co., *Norton s.n.* (US); Riley Co., Manhattan, *Kellerman 367* (F); Trego Co., *Rodin s.n.* (F); KENTUCKY, Christian Co., S of Crofton, *Braun 3526* (US), Clark Co., Boone Creek above Grimes Mill, *Beckett 808* (GH), Jessamine Co., Hwy. 33, 0.3 mi E of Hwy. 68, *Bates 2705* (BH, GH, pf), Logan Co., near Russellville, *Braun 3538* (US), Mercer Co., Burgin, *King 186* (F, US); Warren Co., 12 mi W of Bowling Green, *Deam & Deam 60004* (F); Woodford Co., Hwy. 33, 0.8 mi W of Jessamine Co. line, *Bates 2704* (BH, GH, US); MISSOURI, Bates Co., 2.5 mi S of Butler, *Steyermark 21320* (F); Caldwell Co., Long Creek, 1.5 mi S of Kingston, *Steyermark 6062* (F); Callaway Co., Hwy. AA, 1 mi E of Hwy. 54, *Bates 2688* (BH, GH, US); Cass Co., 3.5 mi W of Peculiar, *Steyermark 5742* (F); Cedar Co., 0.5 mi S of Wagoner, *Steyermark 85798* (GA); Cooper Co., 2 mi NE of Clifton City, *Steyermark 21809* (F); Dallas Co., 3.5 mi S of Buffalo, *Steyermark 24159* (DAO, F); Greene Co., Valley Mill near Springfield, *Standley 8987* (US); Jackson Co., 1.3 mi E of Greenwood, *Bates 2691* (BH, GH, US); *Mackenzie s.n.* (VT); Jasper Co., Webb City, *Bush 9068* (GH); Jefferson Co., NW of Pevely, *Steyermark 4460* (F); Johnson Co., 1 mi W of Fayetteville, *Palmer 66567* (SMU); Laclede Co., Lebanon, Wire Road, *Moore 78* (F); Lafayette Co., 1 mi N of Chapel Hill, *Steyermark 24683a* (F); Lincoln Co., Cuivre River State Park, *Hill 4533* (srh); same locality, *Bates 2686* (BH, pf, TEX, US); McDonald Co., 3 mi E of Powell, *Palmer 61007* (SMU); Moniteau Co., between Kliever and Bacon, *Steyermark 24767* (F); Montgomery Co., E of Loutre River, *Steyermark 15893* (US); Pettis Co., 1.5 mi SW of Lookout, *Steyermark 21478* (F); Pike Co., *Peck s.n.* (F); Ralls Co., 1 mi N of Spaulding, *Steyermark 25711* (F); St. Charles Co., Alton (Allentown), *Letterman s.n.* (DAO, F, US); St. Claire Co., E side of Osage River, *Steyermark 24343* (F); St. Louis Co., St. Louis, *Engelmann s.n.* (F, G, US); Saline Co., 3 mi SW of Ridge Praire, *Steyermark 21555* (F); Stone Co., Galena, *Palmer 4637* (US); OKLAHOMA, Cherokee Co., 1.7 mi NE of Cookson, *Wallis 7989* (SMU); Johnston Co., Tishomingo, *Palmer 6491* (BH, UC, US); Osage Co., 7 mi N of Foraker, *Waterfall 13160* (GH); Sequoyah Co., 6 mi NE of Gore, *Wallis 7709* (SMU); TENNESSEE, Davidson Co., near Nashville, *Gattinger 367* (CU, F, G, PH, US, VT); Rutherford Co., La Vergne, *Svenson 9362* (BKL, GH, UC); Williamson Co., Sneed Rd.

towards Harpeth River, *Kral* 28998 (MICH); Wilson Co., Gladeville, *Demaree* 46345 (SMU).

Section 2. *Interruptum*

Malvastrum sectio **Interruptum** S. R. Hill, *sect. nov.*

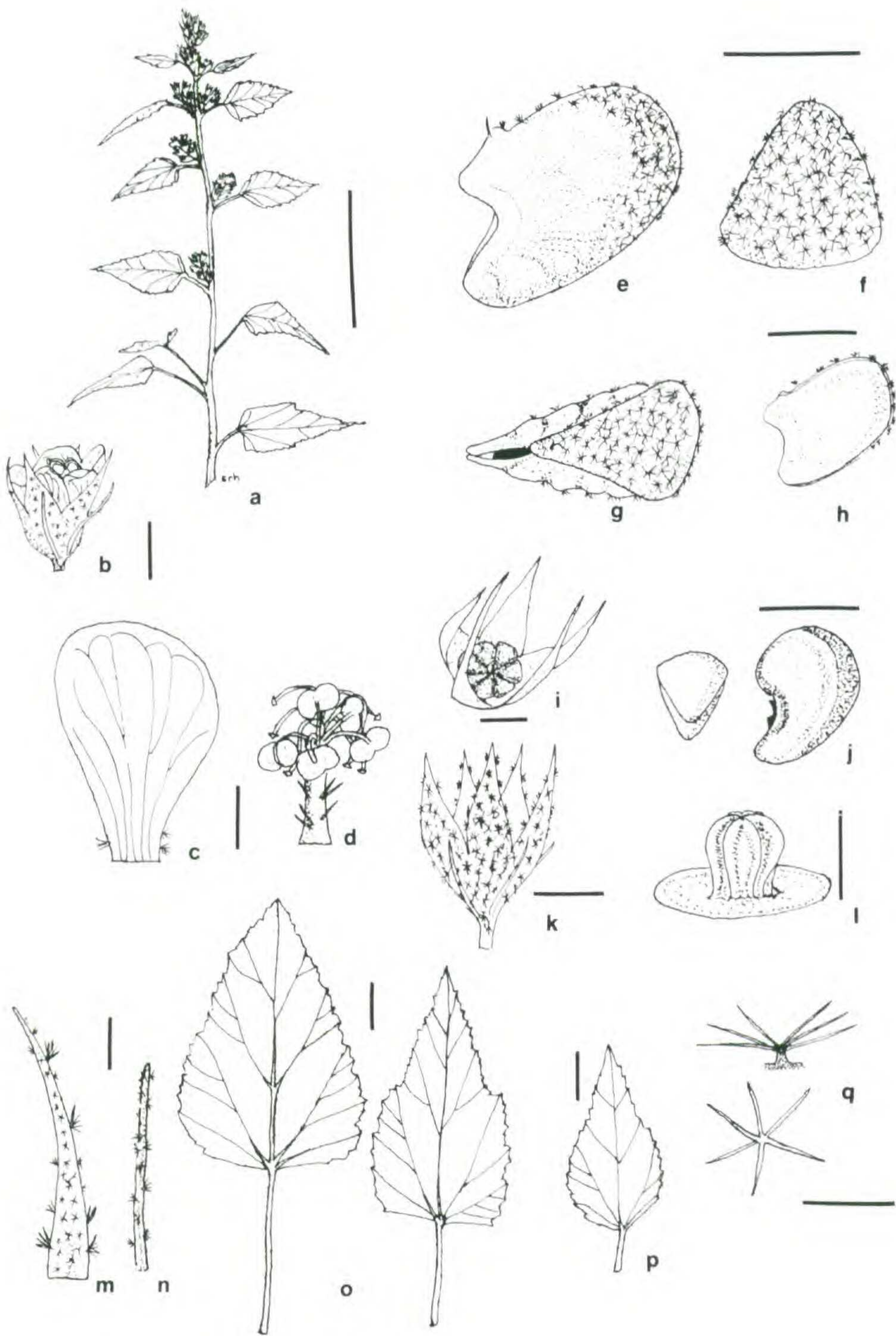
Carpella matura 7–12, indehiscentia, muris lateralibus tenuibus, pilis stellatis solum, inornata vel mucrone proximali-apicali singulo minuto minore quam 0.2 mm longitudine, marginibus pericarpium angulatis, endoglosso nullo; stamina 5–27, columna staminali subglabra; flores in racemis spicatis congestis aphyllis axillaribus vel terminalibus minoribus quam 3 cm longitudine; bracteolae involucelli calyce liberae; bracteae florales bifidae plerumque nullae; pili caulini interdum stipitati; pollinis grana aperturis 4–11. Typus: *Malvastrum interruptum* K. Schumann.

The glomerate axillary and terminal spikes, indehiscent thin-walled and disintegrating unornamented mericarps, the lack of an endoglossum and bifid floral bracts, sparsely pubescent filament tube, and 4–11 aperturate pollen characterize the section *Interruptum*.

2. **Malvastrum spiciflorum** (E. Hassler) A. Krapovickas, *Darwiniana* **10** (4): 634, in textu, 1954. Fig. 21, 22.

Malvastrum pentandrum K. Schumann subsp. *spiciflorum* E. Hassler, Feddes Repert. Spec. Nov. Regni Veg. 23: 495. 1913. TYPE: ARGENTINA. Tucumán: District of Tafí. Bajo de Anfama, alt 1600 m, 8 June 1906. *M. Lillo* 5029. (HOLOTYPE: G!, ISOTYPES: G!, LIL).

Herbaceous to suffruticose sparsely branched perennial or annual 0.6–1.2 m tall with a single *main stem* 3–5 (6) mm diam at base; *branches* 1–5 (25) cm long; *stem vesture* of (4) 5–8-rayed often tuberculate-stipitate stellate hairs (0.5) 1.0–2.0 mm diam, somewhat overlapping, tardily shed in age; *cotyledons* unknown; *stipules* (3) 6–8 mm long × 0.4–0.8 mm wide, reduced in the inflorescence, narrowly lanceolate to linear or subulate, subfalcate, long-acuminate; *petioles* (7) 20–35 mm long, shortest near the stem apex, borne at a 30°–60° angle to the stem above; *blades* 1.6–1.8 to 2.0–2.8× longer than the petioles on main stem and inflorescence-associated leaves respectively, 5–60 (70) mm long × (14) 20–30 (40) mm wide, average midstem blade (1.5) 1.8–2.2× longer than wide, triangular-ovate to ovate-lanceolate, unlobed or briefly 3-lobed half



the distance from the truncate to broadly rounded or wide-cuneate base, apex acute to long-acuminate, margin dentate to twice-dentate in lower leaves to denticulate in upper leaves with 3–6 teeth/cm, vesture of the adaxial surface of sparse to slightly overlapping simple to 2–6-rayed scarcely appressed hairs 0.5–1.0 mm diam, abaxial surface with similar but more dense (6) 10–12-rayed tufted stellate hairs; *flowers* at first solitary, axillary, later in congested axillary and terminal spicate racemes less than 2 cm long and generally shorter than the petioles of subtending leaves, flowers subtended by reduced leaves and their associated stipules or by reduced stipules alone, bifid *floral bracts* lacking; *pedicels* (0.5) 1.0–2.0 mm long and scarcely increasing in fruit; *involucl* of 3 linear bracteoles 2–3 mm long $\times$ 0.2–0.3 mm wide, completely free from the calyx; *calyx* united $1/5$ to $1/4$ its length, campanulate with slightly spreading to erect lobes, 3.5–4.0 mm long to 5–6 mm in fruit, lobes triangular, acuminate, 3.0–3.5 mm long $\times$ 1.5–2.0 mm wide in fruit, abaxial vesture of sparse tufted minute 6–10-rayed stellate hairs 0.05–0.3 mm diam, the largest on the margins of the lobes and conspicuous on the angles of the flower bud, adaxial lobe surface with a few minute arachnoid simple and stellate hairs on the apical $1/4$ and marginally to the sinus; *corolla* yellow, petals asymmetric and unlobed, 3.0–3.5 (4.0) mm long $\times$ 2.0 mm wide, presumably campanulate to slightly spreading, subequal in length to the calyx, claws with 1 or 2 marginal stellate hairs 0.2 mm long; *androecium* with 5–6 (7) stamens, filament tube 1.0–1.4 mm long, subglabrous with 1–5 fine simple or 2–4-rayed stellate hairs similar to those of the petal claws, free portion of filaments 0.2–0.5 mm long; *gynoecium* with 7–8 (10) carpels, the style branching 1.5–2.0 mm above the columella, the branches usually recurved and subequal to the anthers, each stigma slightly expanded subhemi-

Figure 21. *Malvastrum spiciflorum*. a. Habit, scale = 5 cm. b. Flower, scale = 2 mm. c. Petal, scale = 1 mm. d. Stamens, styles, and stigmas, scale = 1 mm. e.–g. Mericarp, lateral, distal, and apical views, scale = 1 mm. h. Mericarp, internal view, scale = 1 mm. i. Fruit, apical view, scale = 2 mm. j. Seed, apical and lateral view, scale = 1 mm. k. Calyx in fruit, lateral view, scale = 2 mm. l. Columella and carpocrater, scale = 0.5 mm. m. Stipule, abaxial surface, scale = 1 mm. o.–p. Leaves, basal to apical, line-scale = 1 cm. q. Stem hairs, line-scale = 0.5 mm. (a,o–p, from Krapovickas, *et al.* 22080; b–d, k, q from Rodrigo 2293; e–j, l, from Lillo 5029).

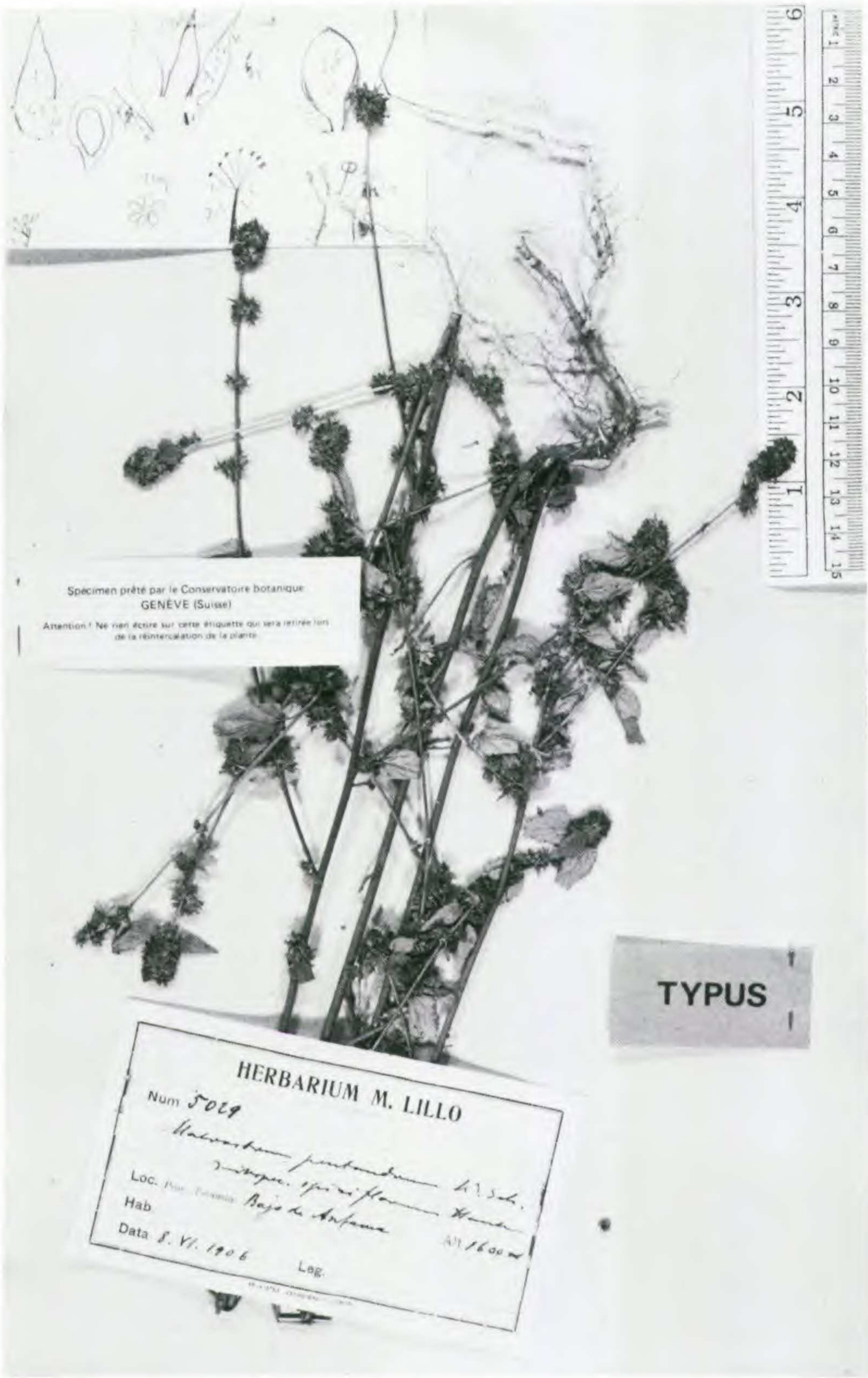


Figure 22. *Malvastrum spiciflorum* (holotype).

spherical and papillose; *schizocarps* 3.0–3.5 mm in diam; *mericarps* 7–8 (10), 1.0–1.5 mm in height $\times$ 1.0–1.5 mm in length $\times$ 1.4 mm in width, the portion below the hilum region of the seed often prolonged, conspicuously wider at the base than apex in distal profile, usually with a single proximal-apical mucro 0.5–0.1 mm long, lateral surfaces minutely granular in appearance, with inconspicuous ribs or reticulate rays more conspicuous at the distal and basal margins, vestiture limited to the apical and distal surfaces, composed of minute 6–10-rayed stellate hairs 0.05 mm diam, occasionally a few proximal hairs bear prolonged rays to 0.1 mm in length, pericarp chartaceous throughout very thin and fragile over the seeds and soon disintegrating, a thin medial line visible on the basal portion of the distal surface, indehiscent but weakly sealed in the proximal-basal region, endoglossum lacking, mericarps readily detaching from the receptacle at maturity but tardily shed due to the obstructing calyx lobes; *seeds* 1.0 mm in height $\times$ 1.0 mm in length $\times$ 0.6–0.7 mm in width; *chromosome number*: $2n = 12$; *pollen* 35.8–59 (50) μm diam, echinae 2.3–4.0 μm , apertures 4–5.

DISTRIBUTION. (Fig. 23) Restricted to highland regions from Córdoba, Argentina in the south to La Paz, Bolivia in the north at elevations of 1600–2700 m, the higher elevations corresponding to the northern populations.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. This species apparently flowers in March–June (local late summer and autumn). The few seeds planted in Texas did not germinate. The primary pollination mechanism is suspected to be self-pollination due to the small inconspicuous corolla and the reduced number of stamens that apparently release their pollen directly onto the stigmas.

DISCUSSION. *Malvastrum spiciflorum* strongly resembles *M. interruptum* at maturity and their ranges coincide. It is apparently local or very scarce throughout its range. This is the only diploid species of *Malvastrum* and so primitive generic characters have been sought here. It is apparent, however, that although *M. spiciflorum* is a diploid, many of its character states are derived or reduced when examined in the genus as a whole. Nevertheless, its distribution is thought to be relictual.

SPECIMENS EXAMINED: **Argentina.** CÓRDOBA: Dpto. Cruz del Eje, Río Pinto, *Rodrigo* 2293 (NY); SALTA: Dpto. Chicoana, Cuesta del Obispo, San Martín, *Krapovickas et al.* 22080 (F, GH, pf, UC, WIS);

La Zanja, *Krapovickas & Schinini 36055* (MARY, srh); TUCUMÁN: Bajo de Anfama, *Lillo 5029* (G); **Bolivia**. LA PAZ: Larecaja, Sorata, *Mandon 817?*, mixed with *M. interruptum*, (GH).

3. ***Malvastrum interruptum*** K. Schumann in Martius, Fl. Bras. 12, 3: 272. 1891. TYPE: ARGENTINA. Córdoba: Dpto. Colón, Sierra Chica near Ascochinga, April 1871. *P. G. Lorentz 276* (LECTOTYPE: GOET!; ISOTYPES: G! US!) Fig. 24, 25

Malvastrum spicatum sensu A. Grisebach, Abh. Königl. Ges. Wiss. Göttingen 19: 89. 1874, non A. Gray, 1849. Grisebach applied this name to several specimens including notably *Lorentz 276*, later the type of *M. interruptum*.

Suffruticose to sub-arborescent sparsely branched perennial herb (1.0) 1.5–2.5 (3.0) m tall with a stout single *main stem* 10–15 mm diam at base; *branches* few, 15–30 cm long on older plants; stem *vesture* of often tuberculate-stipitate 4-rayed stellate hairs 0.6–2.0 mm diam overlapping but not obscuring the stem surface, hairs persistent; *cotyledons* 6–7 mm long $\times$ 8–9 mm wide, wide-ovate, apex rounded, base subtruncate to broadly rounded; *stipules* 5–7 (9) mm long $\times$ 0.7–1.0 mm wide, narrowly-lanceolate to linear or subulate, subfalcate, long-acuminate; *petioles* (7) 16–30 (50) mm long shortest near stem apex, borne at a 30°–60° angle to the stem above; *blades* (1.2) 2.2–3.2 (3.7) $\times$ longer than the petioles, (25) 50–90 (125) mm long $\times$ (12) 25–40 (97) mm wide, average midstem blade 1.7–2.4 $\times$ longer than wide, narrowly triangular-ovate or ovate-lanceolate to wide-ovate (in the earliest seedling leaves), upper surface concave and leaf thus appearing slightly cupped, unlobed or infrequently briefly 3-lobed 1/2 to 2/3 the distance from the broadly cuneate truncate to somewhat reniform-cordate base, apex acute, margin dentate to denticulate with 3–5 teeth/cm, nerves impressed and conspicuous above, *vesture* of the adaxial surface of overlapping but usually not dense 2–4 (6)-rayed stellate hairs 0.3–1.0 mm in diam the rays often directed marginally or apically, abaxial pubescence of usually more dense 10–12-rayed stellate hairs; *flowers* at first solitary in axils of upper main stem leaves, soon in several densely congested and apparently continuous axillary and terminal spicate racemes each less than 3 cm long, flowers subtended by highly reduced leaves and their associated stipules by stipules alone or less frequently by *floral bracts* divided 2/3 to 5/6 their length;

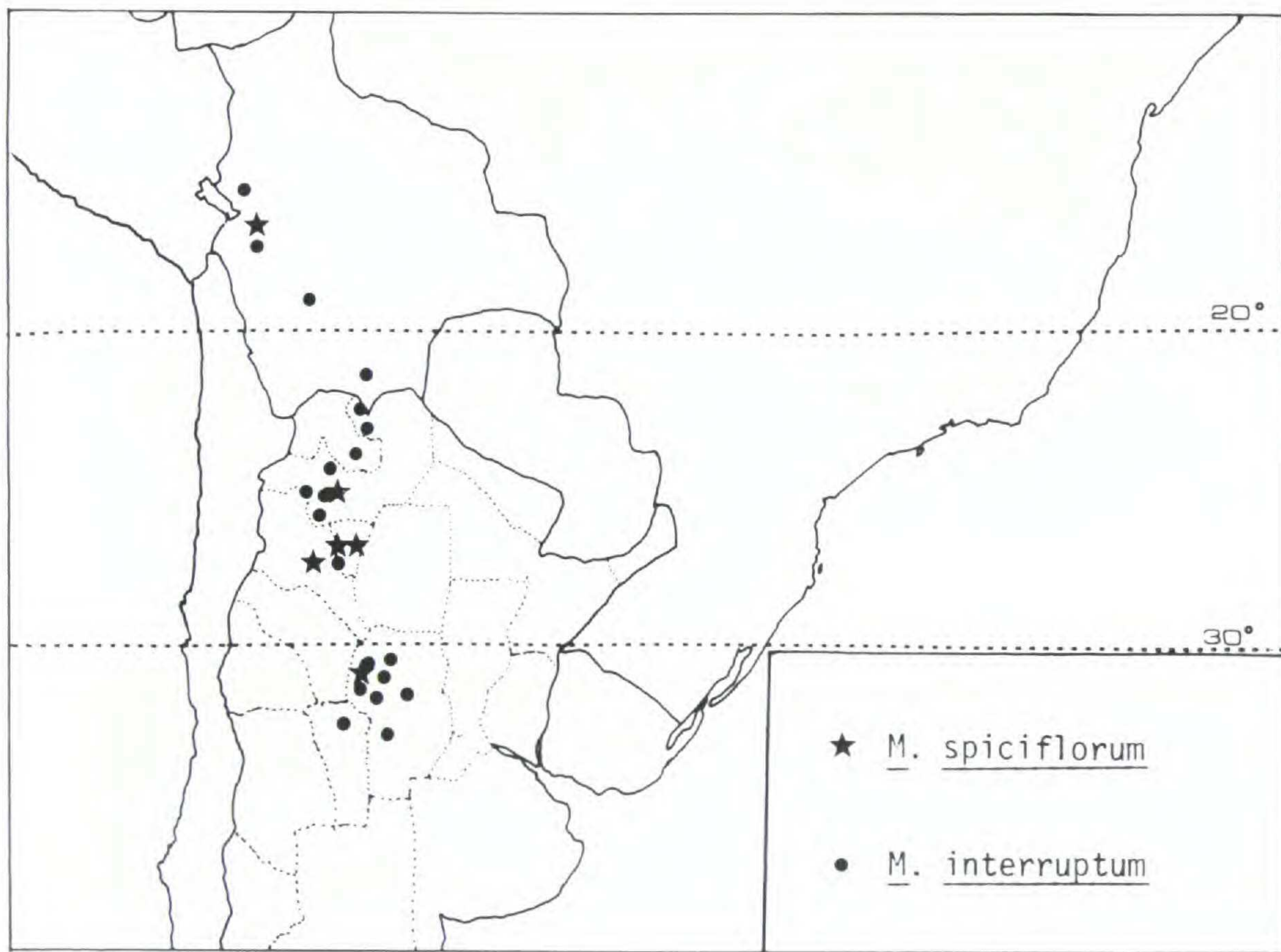
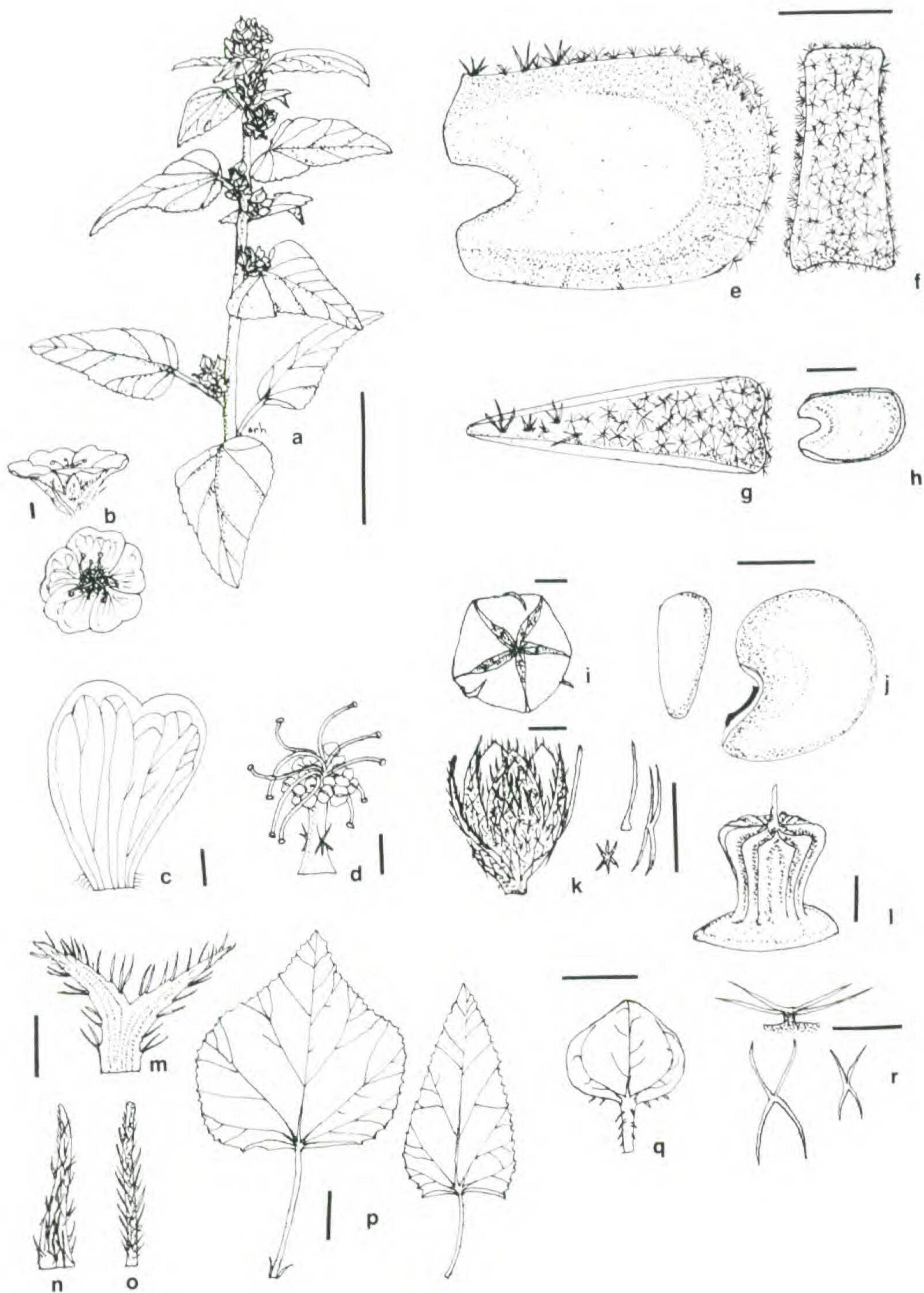


Figure 23. Distribution of *Malvastrum spiciflorum* and *M. interruptum*.



pedicels 0.5–1.5 mm long, scarcely increasing in fruit by less than 1 mm; *involucel* of 3 linear bracteoles 4–5 mm long $\times$ 0.3–0.6 mm wide completely free from the calyx or scarcely adnate in the basal 0.5 mm; *calyx* united $1/3$ to $1/2$ its length, 4.0–4.5 mm long increasing to 8 mm in fruit, broadly campanulate in flower and with incurved lobes in fruit, lobes triangular, acuminate-cuspidate, 5.0–6.5 mm long $\times$ 4.0–4.5 mm wide in fruit, abaxial vestiture of sparse or dense 4-rayed hairs 1.5 mm diam and 4–6-rayed appressed stellate hairs 0.2–0.8 mm diam and usually with simple apically directed marginal hairs 1.0–1.5 mm long, adaxial surface of lobes puberulent on upper half and marginally with minute simple hairs; *corolla* pale yellow, petals slightly asymmetrically bilobed 7–8 mm long (5–6 mm in dried specimens) $\times$ 4–5 mm wide, broadly campanulate, exceeding the calyx by 2–3 mm, claw slightly pubescent basally and marginally with fine simple hairs; *androecium* with 20–22 (27) stamens, filament tube 1.5–2.0 (–2.5) mm long, sparsely pubescent or subglabrous with 1–5 fine-textured 5-rayed stellate hairs 0.5–0.8 mm diam, rarely glabrous, free portion of filaments 1.0 mm long; *gynoecium* with 10–12 carpels, the style branching 1.5–2.0 mm above the columella exceeding the anthers by 1.5–2.0 mm, divergent and usually recurved, each stigma expanded and hemispherical; *schizocarps* 4.5–5.0 mm diam; *mericarps* 10–12, 1.9–2.0 mm in height $\times$ 2.0–2.2 mm in length $\times$ 0.8–1.0 mm in width, slightly mucronate with a mucro 0.1 mm long or less at the proximal apex, otherwise unornamented, lateral surfaces minutely granular in appearance, unribbed or with slight marginal ribs, vestiture of the apical-distal and apical-marginal portion of the lateral surfaces consisting of 2–8-rayed stellate hairs 0.1–0.3 mm diam, a few of the

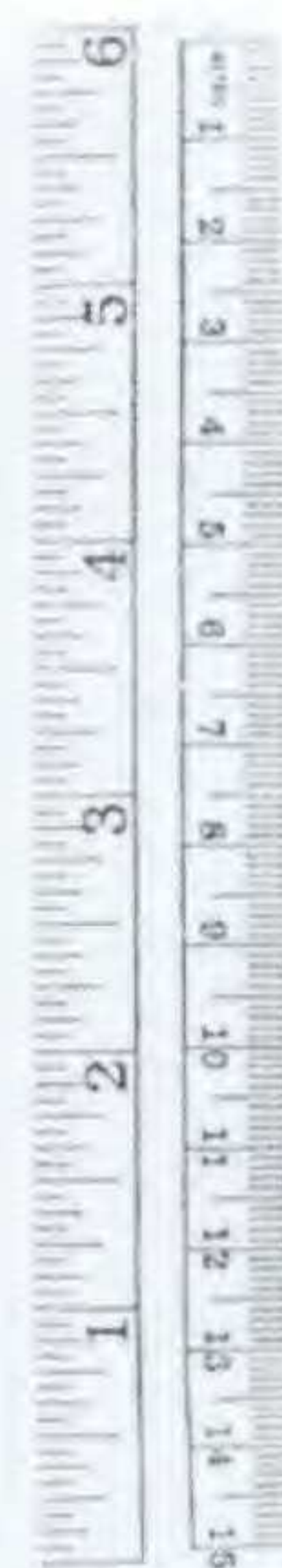
Figure 24. *Malvastrum interruptum*. a. Habit, scale = 5 cm. b. Flower, scale = 2 mm. c. Petal, scale = 2 mm. d. Stamens, styles and stigmas, scale = 1 mm. e.–g. Mericarp, lateral, distal, and apical views, scale = 1 mm. h. Mericarp, internal view, scale = 1 mm. i. Fruit, apical view (vesture not indicated), scale = 2 mm. j. Seed, apical and lateral views, scale = 1 mm. k. Calyx in flower and calyx hairs enlarged, scales = 2 mm and 1 mm respectively. l. Columella and carpocrater, scale = 0.5 mm. m. Floral bract, scale = 2 mm. n. Stipule, scale = 2 mm. o. Bracteole, scale = 2 mm. p. Leaves, basal and midstem, scale = 2 cm. q. Cotyledon, scale = 5 mm. r. Stem hairs, scale = 1 mm. (a–d, i–l, o–q from cultiv. progeny of *Gutiérrez* 357; e–h from *Bailetti* 195; m, r from *Lorentz* 276; n from *Meyer* 3675).

proximal-apical hairs with enlarged rays 0.5 mm long, lateral surfaces of pericarp over the seed translucent and chartaceous, somewhat woody and opaque on remainder, thin and fragile and usually fragmenting to release the seed, indehiscent, endoglossum lacking, mericarp tardily deciduous from the calyx due to the incurved lobes; *seeds* 1.5–1.6 mm in height $\times$ 1.5–1.6 mm in length $\times$ 0.8–0.9 mm in width; *chromosome number*: $n = 18$, $2n = 36$; *pollen* 60–82 (70) μm diam, echinae 3.9–5.1 μm , apertures 6–11.

DISTRIBUTION. (Fig. 23). Restricted to the foothills and mountainous regions from San Luis and Córdoba, Argentina in the south, north to La Paz, Bolivia, at elevations of 500 m in the south to 2700 m in the north.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Where indigenous, flowering from January to May (local summer and autumn) and occasionally as early as November, the old fruits often persist throughout the year. Some seeds are viable for at least 27 years. In greenhouse-grown plants in Texas (seeds from *Gutiérrez* 357 and *Krapovickas et al.* 22103) seeds germinated in 1–3 weeks, and the plants produced their first flowers in late-August and early September (local late summer and early autumn) after 100–120 days of growth and continued flowering until December. Flowers generally opened at 3–3:30 pm CST and closed at 5:30–6 pm CST. Anthers failed to dehisce in the elevated greenhouse temperatures in August and September (29°–35° C) but dehiscence was normal in October and November. The stigmas were well-separated from the anther column but tended to recurve and thus self-pollinate by the time the flower wilted. Emasculated flowers did not set fruit. Fruits were mature 21–26 days after pollination.

DISCUSSION. During the latter half of the last century this species was often confused with *Malvastrum americanum* (then usually known as *M. spicatum*) since at full maturity the upper axillary spikes merge to form what appears to be a single terminal spike and because both species are rather robust. Actually the two species have no obvious relationship and are only superficially similar in that one regard. When its characters are examined it is seen to resemble more strongly *M. spiciflorum*. The plant is a hexaploid, without any close similarity to the only other known hexaploid in

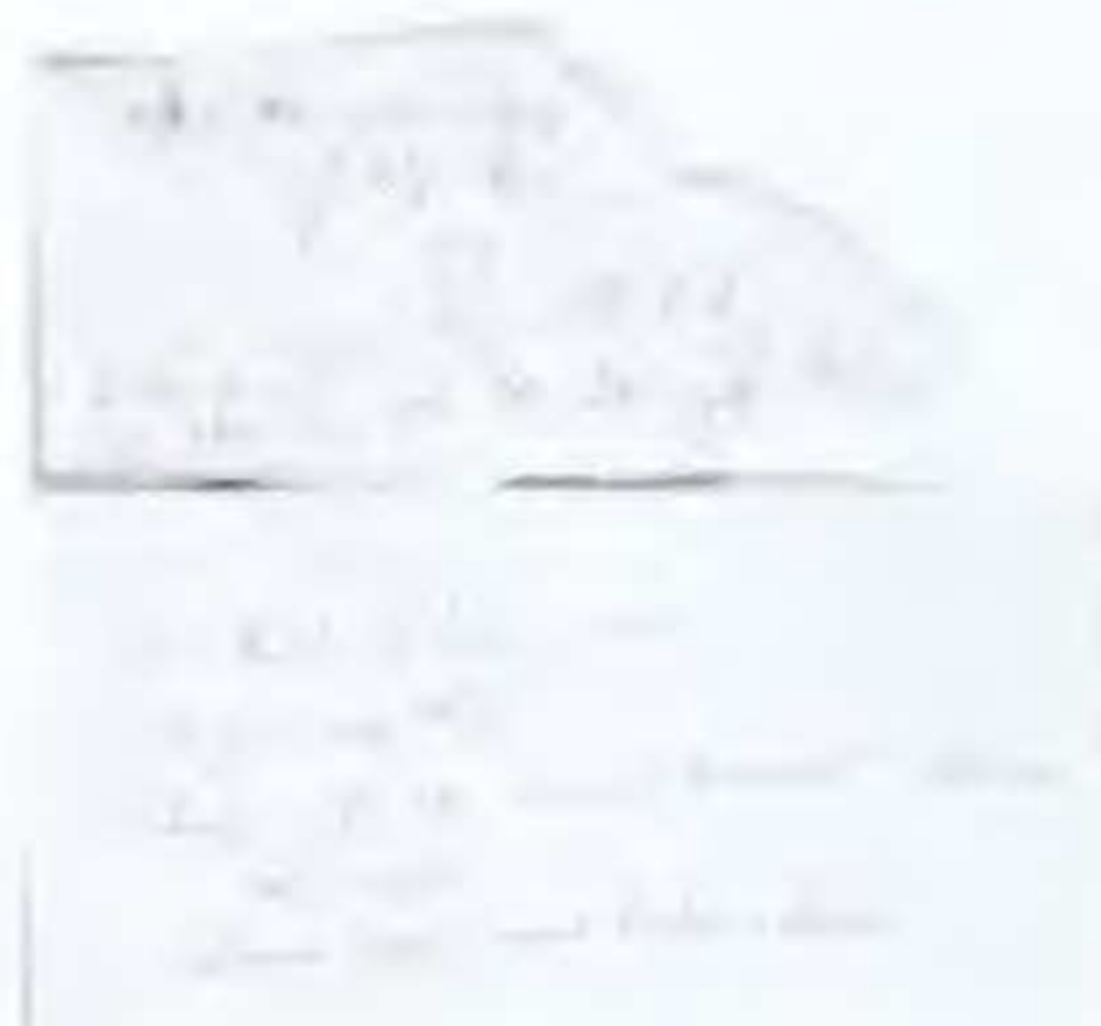


Malvastrum interruptum K. Schumann.
(+ac-) Syntypus



Göttingen 19

8c 270 *Malvastrum interruptum* K. Schumann
Göttingen, Göttingen, u. d. Weymündchen
bei Göttingen, eine malische
Kraut. N. G. Göttingen
April 1871.



Herb. Göttingen

the genus, *M. aurantiacum*. It is my impression that this and *M. spiciflorum* are old species within the genus and have inhabited their present ranges in the stable upland Pampean massif region perhaps since their first appearance with minor changes in range during glaciation.

REPRESENTATIVE SPECIMENS: **Argentina.** CATAMARCA: Dpto. Ambato, Alrededores del Rodeo, *Cristóbal* 415 (UC); CÓRDOBA: Dpto. Calamuchita, Dique los Molinos, *Krapovickas & Cristóbal* 14719 (C, pf); Dpto. Colón, Ascochinga, *O'Donnell & Rodrigues-V.* 406 (A, U); Dpto. Punilla, Puerto Punilla, *Gutiérrez* 357 (NY, SMU); La Falda, *Rodrigo* 2297 (NY); Dpto. Santa María, Puesto el Cura, *Pierotti s.n.* (U); JUJUY: Dpto. Capital, 25 km NE of Jujuy, *Eyerdam & Beetle* 22209 (GH, K, UC); Dpto. Tumbaya, Volcán, *Cabrera* 12164 (F); SALTA: Dpto. Candelario, Agua Caliente, *Venturi* 3728 (GH); Dpto. Chicoana, 16 km W of Chicoana, *Krapovickas et al.* 22103 (pf); Dpto. Rosario de Lerma, Campo Quijano, *Meyer* 3675 (GH, NY); SANTA FE: Rosario, *Schnyder s.n.* (US); TUCUMÁN: Dpto. Burruyacu, Cerro del Campo, *Bailetti* 195 (A); Dpto. Capital, *Lillo* 2238 (G); Dpto. Río Chico, Escoba (Cumbre de Santa Ana), *Monetti* 1698 (U); Dpto. Taí, *Venturi* 801 (A, U, US); Dpto. Trancas, Río Taipamayo, *Venturi* 4310 (US); **Bolivia.** COCHABAMBA: Valle del Cercado de Cochabamba, *Steinbach* 185 (GH, U, UMO); LA PAZ: Illimani, *Buchteit* 3214 (GH, NY, US); TARIJA: Tarija, Escuela de Agricultura, *Krapovickas et al.* 18808 (pf, UC).

Section 3. *Americanum*

Malvastrum sectio **Americanum** S. R. Hill, *sect. nov.*

Carpella matura 7–18, indehiscentia vel partim basi et margine proximali-apicali dehiscentia muris lateralibus pericarpium crassis, pilis simplicibus vel pilis stellatis infrequenter cum simplicibus intermixtis, inornata vel mucrone proximali-apicali singulo minuto minore quam 0.2 mm longitudine, marginibus pericarpium angulatis, endoglosso praesenti vel nullo; stamina 18–49, columna staminali pubescenti; flores (1–5) solitarii axillares, demum in spicis vel racemis terminalibus foliaceis infra majoribus quam 3 cm longitudine; bracteolae involucelli basi ad calycem adnatae vel liberae; bractae florales bifidae praesentes; pili caulini nunquam stipitati; pollinis grana aperturis 6–8. Typus: *Malvastrum americanum* (L.) Torrey.

The compact leafy terminal spikes or racemes, firm-walled briefly mucronate or unornamented mericarps, pubescent filament tube, bifid floral bracts, and 6–8 aperturate pollen characterize the section *Americanum*.

4a. ***Malvastrum americanum*** (Linnaeus) Torrey in Emory var. ***americanum***, Rep. U.S. Mex. Bound. Surv. 2, 1. Botany: 38. 1859. Fig. 26, 27.

- Malva americana* Linnaeus, Sp. Pl. 2: 687. 1753. TYPE: Hortus Leydensis, A. van Royen s.n. (LECTOTYPE: L 908.139-311 PROBABLE ISOTYPE: G!). See discussion. *Malveopsis americana* (Linnaeus) O. Kuntze, Rev. Gen. 1: 72. 1891, quoad basionym, excl. syn. et specim. Kuntze misapplied this name to *M. coromandelianum* (L.) Garcke. *Sphaeralcea americana* (Linnaeus) Metz, Catholic Univ. Amer. Biol. Ser. 16: 142. 1934, quoad basionym, excl. specim. Metz misapplied this name to *M. coromandelianum* (L.) Garcke.
- Malva spicata* Linnaeus, Syst. Nat. ed. 10, 2: 1146. 1759. TYPE: Jamaica, H. Sloane s.n. (LECTOTYPE: Sloane Herbarium, BM-(photo Killip neg. no. 616-F!, G!, US!)). See discussion. *Malva spicata* Linnaeus var. β *foliis-subcordatis* De Candolle, Prodrum 1: 430. 1824. Described as the typical form of Linnaeus' species. *Malvastrum spicatum* (Linnaeus) A. Gray, Mem. Amer. Acad. Arts n.s. 4: 22, in adn. 1849. *Malveopsis spicata* (Linnaeus) O. Kuntze var. α *normalis* O. Kuntze, Rev. Gen. 1: 72. 1891.
- Malva gangetica* Linnaeus, Sp. Pl. ed 2, 2: 967. 1763. TYPE: t. 74, f. 6 in Plukenet, Phytographia, 1692, apparently the sole basis for the name, is chosen as lectotype. See discussion.
- Malva ovata* Cavanilles, Diss. Bot. 2: 81, t. 20, f. 2. 1786. TYPE: Commerson s.n. (HOLOTYPE: C!). See discussion. *Malva spicata* Linnaeus var. α *foliis-ovatis* De Candolle, Prodrum 1: 430. 1824. Based upon Cavanilles' plate; there are no specimens in the De Candolle Herbarium (G-DC) bearing this name.
- Malva polystachya* Cavanilles, Diss. Bot. 5: 281, t. 138, f. 3. 1788. TYPE: Lagasca s.n. cultiv. in R. H. Matritensis, (LECTOTYPE: G). See discussion.
- Malva curassavica* Desrousseaux in Lamarck, Encycl. 3: 754. 1792. TYPE: Not determined. Desrousseaux stated that he had seen dried specimens from Curaçao and also cited Breynius (Exot. Pl. Cent.: 124, t. 57. 1678), the latter cited by Linnaeus as *M. americana*. Specimens should be sought at P-LA.
- Malva betulina* Desrousseaux in Lamarck var. β , Encycl. 3: 754. 1792. TYPE: plants raised from seed at Hortus Parisiensis from seed in part sent by Martin, Santo Domingo; a single leaf represents this variety, mounted with the typical variety, which is *M. corchorifolium* (HOLOTYPE: P-LA); confirmed by Krapovickas (pers. comm.).
- Malva sublobata* Desrousseaux in Lamarck, Encycl. 3: 754. 1792. TYPE: no authentic specimens known, but may exist at P-LA. Desrousseaux stated that he had observed this species at Hortus Parisiensis growing under the name *Malva gangetica*; his description clearly refers to *Malvastrum americanum*.
- Malva borbonica* Willdenow, Enum. Plant.: 728. 1809. TYPE: Mauritius and Réunion (fide descr.) (LECTOTYPE: B-W-microfiche no. 12749, sheet 2). In the Willdenow herbarium under no. 12749 are two specimens: sheet 1 bears a fragment of *Melochia corchorifolia* and of *Malvastrum coromandelianum*, and sheet 2 bears a specimen of *M. americanum*; the original description fits the latter specimen particularly well. In the Bernhardt



Herbarium (MO) there is a specimen under this name, but no additional data is given; it may or may not be an isotype.

Malva trachelifolia Link, Enum. Plant.: 209. 1822. TYPE: The description may serve as type, as Link's Berlin types have been lost. The description best fits *M. americanum*, indicating yellow flowers, cordate leaves, and a capitate inflorescence. *Malvastrum trachelifolium* (Link) Ulbrich, Feddes Repert. Spec. Nov. Regni Veg. 13: 509. 1915.

?*Malva lagascae* Hort. ex De Candolle, Prodrum 1: 430. 1824, pro syn., nom. nud. The specimen upon which this name was based (TO - photo srh!) may be a sterile specimen of *M. americanum* and is tentatively assigned here. The specimen has briefly 3-lobed leaves, but the petioles are rather long for *M. americanum*.

Malva timoriensis De Candolle, Prodrum 1: 430. 1824. TYPE: Timor, ex Museum de Paris, 1821, ? *Riedlé s.n.* (HOLOTYPE: G-DC - microfiche 430.7; ISOTYPES: G!, K!, L 908.137-308). *Malva blumeana* Steudel, Nom. Bot. ed. 2, 2: 94. 1841. Steudel's name was based upon *Malva timoriensis* cited in Blume (Bijdr 2: 64. 1825) thought to be possibly different from that of De Candolle which it apparently is not.

Malva fluminensis Vellozo, Fl. Flumin.: 287. 1825. et Icones 7: t. 48. 1831. TYPE: Brazil, Rio de Janeiro, seacoast, presumably collected by Vellozo. Specimen, according to Vellozo, in the "Cabinet d'Histoire naturelle de Rio de Janeiro". (?RB) No specimens seen. Both the description and plate clearly indicate *M. americanum*.

Malva macrostachya Presl. Rel. Haenk. 2, 2: 120. 1835. TYPE: Mexico: Guerrero. Acapulco harbor, 1790? *T. Haenke ?s.n.* (HOLOTYPE: presumably PR, not seen). The description clearly indicates *M. americanum*, known to occur in this area. *Malveopsis macrostachya* (Presl) O. Kuntze, Rev. Gen. 1: 72. 1891.

Malva astrolasia Zippel ex Spanoghe, Linnaea 15: 168. 1841. nomen nudum, pro syn. Listed as a synonym of *Malva timoriensis* De Candolle. No specimens cited, presumably based on a Zippel collection; a manuscript name.

Figure 26. *Malvastrum americanum* var. *americanum*. a. Habit, scale = 5 cm. b. Flower bud with bract, hairs not included, scale = 5 cm. c. Flower, scale = 5 mm. d. Petal, scale = 2 mm. e. Stamens, styles, and stigmas, scale = 2 mm. f.-h. Mericarp, lateral, distal and apical views, scale = 1 mm. i. Mericarp, internal surface, scale = 1 mm. j. Fruit, without vesture, scale = 2 mm. k. Seed, scale = 1 mm. l. Calyx in flower, vesture of one lobe indicated, and hairs, scales = 2 mm and 1 mm, respectively. m. Columella and carpocrater, scale = 1 mm. n. Floral bract, adaxial surface, scale = 1 mm. o. Stipule, abaxial surface, scale = 1 mm. p. Bracteole, adaxial surface, scale = 1 mm. q. Mid-stem leaf variation, scale = 2 cm. r. Cotyledon, scale = 2 mm. s. Stem hairs, scale = 0.5 mm. (a-b, q(5) from progeny of *Silva-Santos* 28017; c-d, f-j, m from *Hill* 8093; e, o-p from *Hill* 6054; k-l from *Croat* 21340; n, q(2), s from *Ventura* 2622; q(1) from *Dorantes, et al.* 5369; q(3) from *Romero-Castañeda* 10570; q(4) from *Board* 1098; r from progeny of *Koch & Fryxell* 78290).

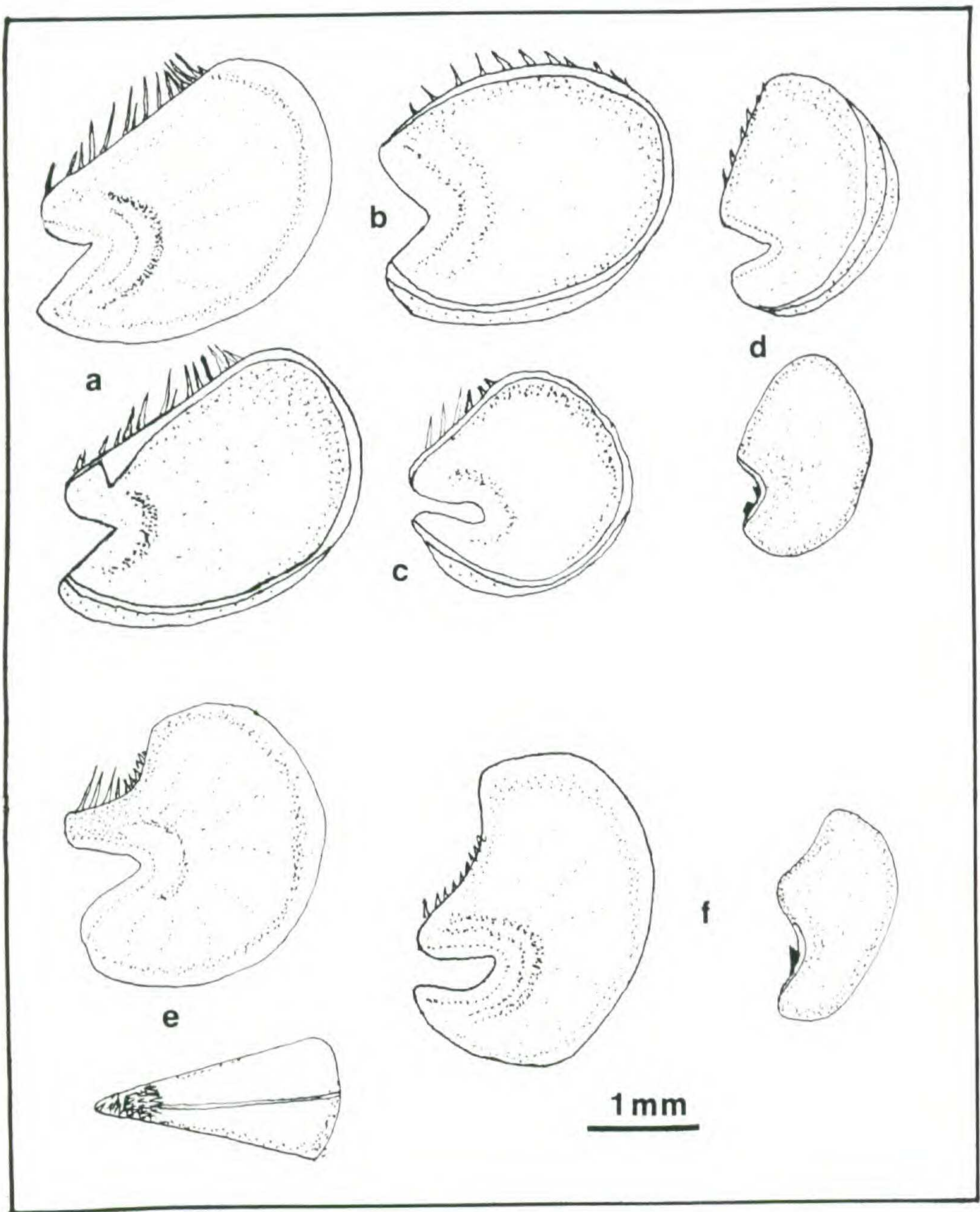


Figure 27. Mericarp and seed variation in *Malvastrum americanum* var. *americanum* in Australia. a. Purdie & Boyland 35, lateral and internal views. b. Adams 1058. c. Sillar 2. d. Hubbard 7382, external view and seed (lower). e. Blake 8894, external and apical views, f. Michael 1287, lateral view and seed.

- Malva brachystachya* F. von Müller, *Linnaea* 25: 378. 1853. TYPE: Australia, rocky and shaded margins of Sulteyer Creek and Mt. Gullert Creek, Flinders Range, *F. von Mueller s.n.* (SYNTYPES: BM, K, MEL). Müller mistakenly referred to "*M. ovata* Hook. in Mitchell trop. Austr. 397, non Cavanilles" as the basis of the name thinking it a later homonym. Hooker was explicitly referring to Cavanilles' plant. Müller's name is based on a separate type.
- Malveopsis spicata* (L.) O. Kuntze var. α *normalis* O. Kuntze f. *flava* O. Kuntze, *Rev. Gen.* 1: 72. 1891. Kuntze's entire description and citation consists of the following: "Flores flavi. Portorico." No Kuntze specimens from Puerto Rico have been seen, and it seems as if the name was based upon an assemblage of typical specimens from that island.
- Malveopsis spicata* (L.) O. Kuntze var. α *normalis* O. Kuntze f. *rubra* O. Kuntze, *Rev. Gen.* 1: 72. 1891. "Flores rubescentes. Trinidad." No Kuntze specimens from Trinidad have been found. Kuntze probably based this name on dried specimens whose corolla had faded to a pink tint, not infrequently seen.
- Malveopsis spicata* (L.) O. Kuntze var. β *pauciflora* O. Kuntze, *Rev. Gen.* 1: 72. 1891. "Flores axillares solitarii". No specimens were cited. Probably based upon young specimens of *M. americanum*.
- Malveopsis spicata* (L.) O. Kuntze var. β *pauciflora* O. Kuntze f. *flava* O. Kuntze, *Rev. Gen.* 1: 72. 1891, nomen nudum. Said to be from Trinidad, Kuntze likely considered this to be the typical form of his variety, but did not explicitly say so and supplied no description.
- Malveopsis spicata* (L.) O. Kuntze var. β *pauciflora* O. Kuntze f. *aurantiaca* O. Kuntze, *Rev. Gen.* 1: 72. 1891, nomen nudum. Presumed to be from Venezuela: Porto Cabello. The listing is not clear. No description is given for this form, and it seems to be associated with the next variety in this listing.
- Malveopsis spicata* (L.) O. Kuntze var. *ovata* O. Kuntze, *Rev. Gen.* 1: 72. 1891. This name is attributed to Grisebach without a citation, but Grisebach is not known to have published this name. The description and citation follows: "Folia minora haud lobulata. Venezuela: Porto Cabello." No Kuntze specimens from this area have been found. The name does not seem to be based on that of Cavanilles. The name was probably based upon xerophytic forms or old individuals of the species.
- Malvastrum spicatum* (Linnaeus) A. Gray var. *mollissima* Chevalier, *Rev. Bot. Appl. Agr. Trop.* 15: 944. 1935. TYPE: Cape Verde Islands: Boa Vista, near Sal Rei, 1934, *A.J.B. Chevalier* 44,367 (LECTOTYPE: P). Based upon dwarfed, apparently grazed forms of the species.

Herbaceous to suffrutescent often bushy-branched perennial (0.4) 1.0–2.0 (3) m tall; *main stem* (3) 4–10 (15) mm diam at the base, *primary branches* (10) 30–100 cm long, stem canescent with overlapping sessile or infrequently pustular-based (5) 6–8 (10)-rayed stellate hairs (0.3) 0.8–1.5 mm diam tardily shed in age; *cotyledons* ca. 7 mm long $\times$ 8 mm wide, wide-ovate, apex emarginate, base

subcordate to subtruncate; *stipules* (2) 3–5 (8) mm long $\times$ 0.6–1.0 mm wide, subfalcate, lanceolate, acuminate; *petioles* (15) 35–80 (100) mm long on early vegetative or lower stem leaves, considerably reduced to (4) 10–15 (30) mm on leaves near branch apices and on xerophytes; *blades* (1.2) 1.5–2.2 $\times$ longer than petioles in lower leaves and (2.1) 3–5 $\times$ longer in apical leaves, early vegetative and midstem leaves (40) 50–115 (145) mm long $\times$ (25) 40–100 (140) mm wide and those towards branch apices and inflorescences or on xerophytes (11) 20–40 (50) mm long $\times$ (7) 15–30 (40) mm wide, average midstem blade 1.2–1.6 $\times$ longer than wide, ovate wide-ovate to ovate-lanceolate, often briefly 3-lobed ca. halfway from the cordate truncate to rounded or wide-cuneate base, apex acute to acuminate, margin dentate in lower leaves to denticulate in upper leaves with 2–7 teeth/cm, vestiture of the adaxial surface of regularly arranged scarcely to slightly overlapping (5) 6 (8)-rayed stellate hairs 0.8–1.2 mm in diam, abaxial surface pubescent with similar scattered (8) 10–12-rayed stellate hairs usually 0.3–0.8 mm diam; *flowers* (the first 1–2) infrequently solitary axillary, then in congested terminal spikes (2) 3–10 (18) cm long $\times$ 12–17 mm diam terminating every branch, flowers subtended by a bifid *floral bract* divided 1/3 to 1/2 its length, (3) 4–5 (6) mm long $\times$ 2 mm wide; *pedicels* essentially lacking, up to 3 mm long on the early solitary flowers and 0.1 mm on flowers in spikes, not lengthening in fruit; *involucl* of 3 lanceolate, subfalcate, acute to acuminate bracteoles (4) 5–7 (9) mm long $\times$ 0.8–1.5 mm wide, equalling or exceeding calyx-lobes by <1 mm in flower, adnate to the calyx in the basal (1.0) 1.5–2.0 mm; *calyx* united 1/4 to 1/3 its length, broadly campanulate in flower, indistinctly angled, 5–6 mm long increasing to 6–10 mm in fruit, the triangular to deltate lobes generally incurved and slightly accrescent in fruit, 3 mm long $\times$ 2–2.5 mm wide in flower and 5–7 mm long $\times$ 4 mm wide in fruit, abaxial surface rather densely hirsute with scattered appressed rigid apically directed simple hairs 1.0–1.5 (2.0) mm long mixed with minute 5–8-rayed closely appressed stellate hairs 0.05–0.3 mm diam and with a few stellate hairs similar to those of the stem, adaxial surface subglabrous with a few minute arachnoid hairs on the apical and medial 1/3 continuing marginally to the sinus; *corolla* (12) 13–15 (17) mm diam at anthesis, orange-yellow, petals obovate and briefly asymmetrically lobed, 6–8 (10) mm long $\times$ 4–5 (6) mm wide, rotate and nearly planar, exceeding the calyx by 2–3 mm, claws ciliate with

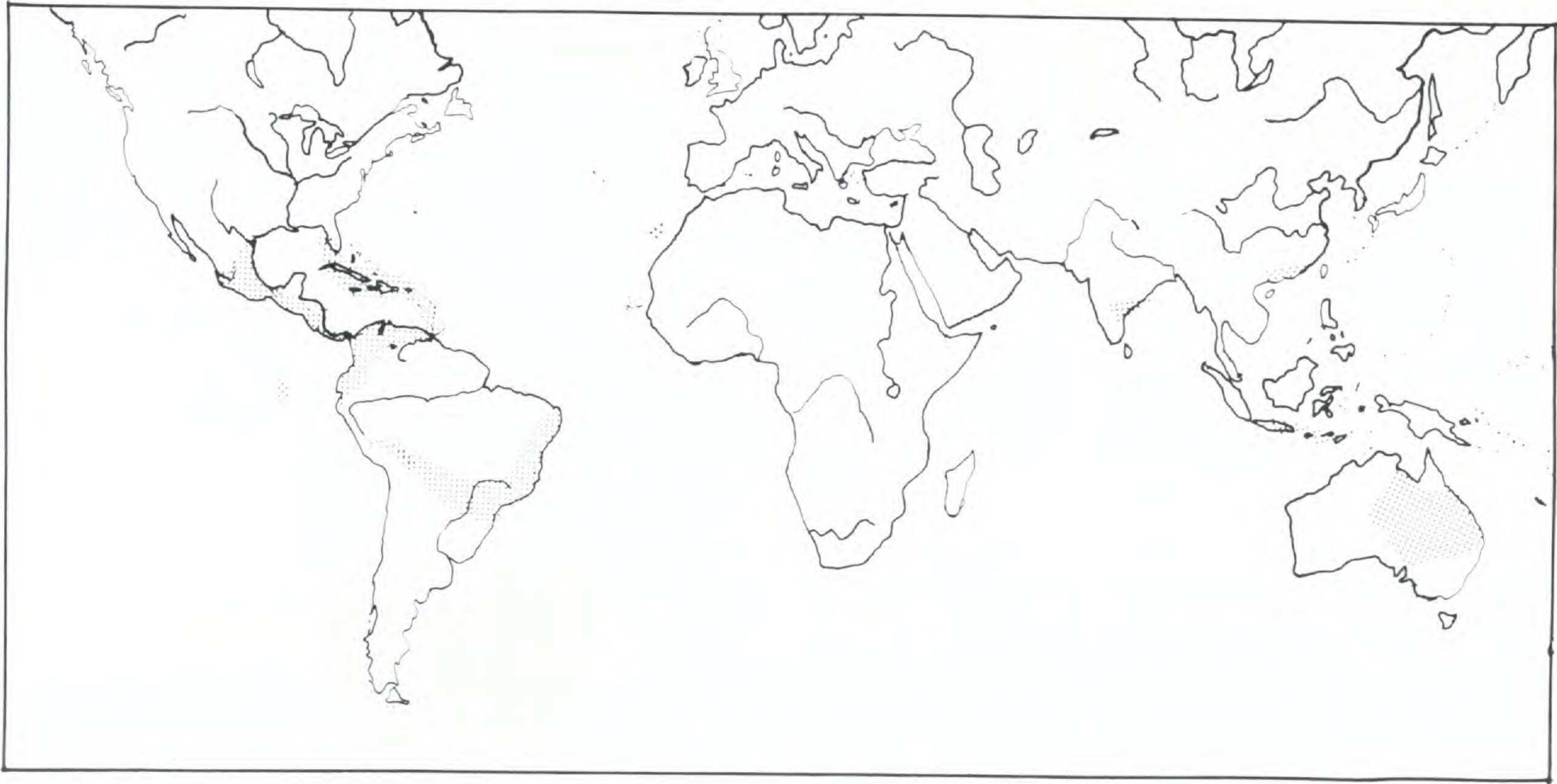


Figure 28. Distribution of *Malvastrum americanum* var. *americanum*.

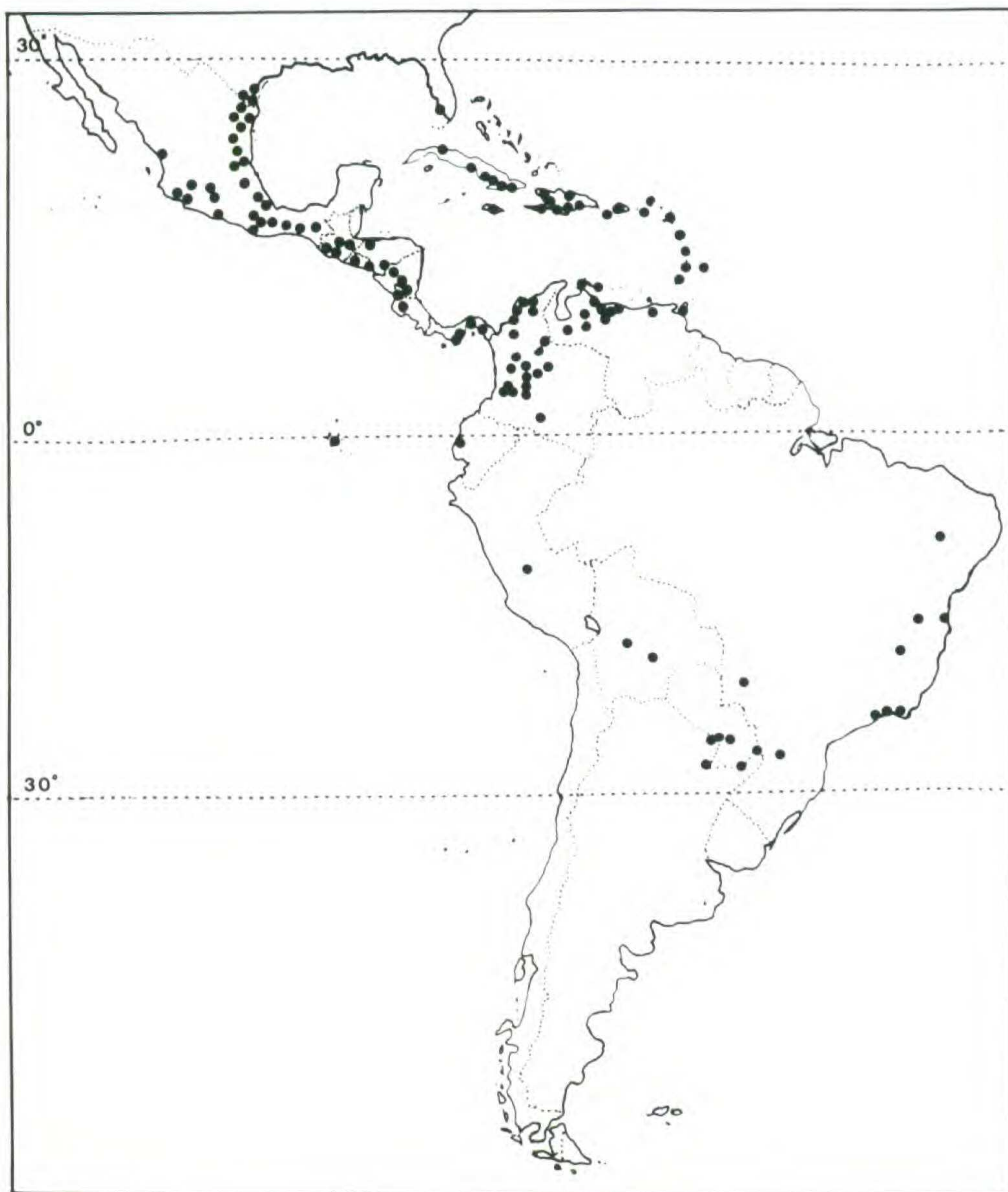


Figure 29. Western Hemisphere distribution of *Malvastrum americanum* var. *americanum*.

tufted simple or stellate hairs 0.5–0.8 mm long; *androecium* of (18) 30–40 (49) stamens, filament tube 2.0–2.5 (3.0) mm long, pubescent with delicate 2–6-rayed stellate hairs 0.2–0.5 mm diam, free portion of filaments 1.0 mm long, anthers 0.5–0.7 mm long $\times$ 0.3–0.4 mm wide after dehiscence; *gynoecium* with (9) 10–15 (18) carpels, the style branching 2.5–3.0 mm above the columella, each branch terminated by a slightly expanded subglobose papillose stigma

exserted 1.0–1.5 mm beyond the anther cluster, reflexed at flower wilt; *schizocarps* (4.0) 5–6.0 mm diam; *mericarps* (9) 10–15 (18), conspicuously separate from one another, 1.5–2.0 mm in height $\times$ 1.5–2.5 (3.0) mm in length $\times$ 0.8 mm wide rarely vertically elongated, usually with a minute proximal-apical mucro < 0.1 mm long, lateral faces conspicuously or inconspicuously ribbed, distal-basal surface with a somewhat inconspicuous raised medial line, vestiture of ascending simple rigid hairs 0.1–0.5 mm long directed proximally and restricted to the apical surface and the extreme apical margin of the lateral surfaces, pericarp chartaceous over the seed, firm distally, often partially dehiscent along the basal-proximal midline and releasing the seed while still in the calyx, and weakly dehiscent at the proximal-apical margin but the valves not separating, endoglossum 0.3 mm long positioned 0.3 mm distal to the proximal margin (except in some Australian populations in which it is reduced or absent), mericarps and seeds tardily shed from the calyx due to the lobe orientation; *seeds* 1.3–1.5 mm in height $\times$ 1.3–1.7 mm in length $\times$ 0.6–0.8 mm wide; *chromosome number*: $n = 12$, $2n = 24$; *pollen* (41) 51.2–72 (60) μm diam, *echinae* 3–5 μm , apertures 6–10.

DISTRIBUTION. (Fig. 28, 29). Pantropical, often weedy, found in both native and introduced populations between 28° N and 28° S, most frequently in subhumid or humid regions; in the Western Hemisphere occurring from south Texas and south Florida south through the Caribbean and Central America to coastal and highland regions surrounding the Amazon basin to northern Argentina, at elevations of near sea level to 1500 m or to 2150 m near the equator. In Australia it is widespread in the eastern portion of the continent.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. At the northern extreme of its range in southern Texas, *Malvastrum americanum* flowers nearly all year when sufficiently warm, from February until November. In other portions of its range it flowers at any time of the year after sufficient rainfall. Seeds up to 15 years old planted in a greenhouse at College Station, Texas (progeny of Hill 6054, Percival s.n., Ventura 2622, Breedlove 35899, Molina 11644 and 27315, Seymour 2362, Williams et al. 23805, Fryxell 2861, Croat 21340, Trujillo 8683, and Silva-Santos 28017) germinated in 4 to 14 days. The Texas plants first flowered 90 days after germination (in

late summer). Plants from the other populations did not begin flowering until mid-November after 240 days of growth, possibly due to genetic controls on maturation as well as on photoperiodicity. Plants transplanted from Texas populations (*Hill 7640*) flowered nearly all year after the transplantation.

The flowers on all populations opened at approximately 4:30–4:45 pm CST and closed at 6:30–6:45 pm CST, local sunset. This period shifted one hour later in the summer (taking into account local standard time) probably due to the increased daylight, but the duration remained the same. At the time of opening the stigmas were conspicuously remote from the anther cluster, but after one hour began to recurve and were covered with pollen at the time of flower wilt. A considerable number of pollinators were observed in the field (see Table 2). Both cross-pollination and selfing appear to be frequent in the species. Fruits were mature in 15–19 days after pollination. Emasculated flowers did not set fruit.

DISCUSSION. Problems of typification are widespread in the literature on *Malvastrum americanum*. The lectotype of *Malva americana* Linnaeus was chosen by van Borssum-Waalkes (1966, p. 154–155). Linnaeus cited van Royen (Fl. Leyd, Prod.: 357, erroneously 359. 1740) and Breynius (Exot. Pl. Cent.: 124, t. 57. 1678). Both citations clearly refer to this species. The lectotype is a specimen in the Rijksherbarium at Leiden bearing a label with van Royen's script upon which is inscribed Linnaeus' binomial as well as a reference to van Royen's own description. The specimen is considered to be part of the protologue of *Malva americana*, and its choice as lectotype seems appropriate. There are no specimens in the Linnaean Herbarium bearing this name. A duplicate specimen with all of the above script is also in Geneva, and is apparently an isotype.

Malva spicata Linnaeus was based upon a description and plate of Sloane (Voy. Jam.: t. 138, f. 1. 1707). The description in Sloane's work, p. 218, can fit *Malvastrum americanum*, but can also describe *Melochia villosa*, which t. 138, f. 1 seems to illustrate. No mention is made of flower color by Sloane. However, in the Sloane Herbarium (BM) is a specimen of *Malvastrum americanum* annotated as "Althaea spicata", here considered part of the protologue and chosen as lectotype. In the Linnaean Herbarium (LINN) is a specimen annotated as *Malva spicata* from Jamaica, under the

number 870.1. This specimen, possibly collected by P. Browne, may have been the basis for the more complete description of the species published by Linnaeus and his student G. Elmgren in a dissertation in November of the same year (Pug. Jamaic. Plant.: no. 62. 1759). There is no evidence that this specimen was seen by Linnaeus before the original description. It is unfortunate that Linnaeus was unaware that he had described the same species under a different name at an earlier date.

Malva gangetica Linnaeus was described as "Malva foliis cordatis obtusis scabris, floribus sessilibus glomeratis axillis denis muticis crenulatis" by Linnaeus (Sp. Pl. ed. 2, 2: 967. 1763), and Plukenet's illustration (Phytographia: t. 74, f. 6. 1692) was cited. This figure, while poor seems to represent a young plant of *Malvastrum americanum*. Early specimens in the Willdenow Herbarium (B-W) bearing this name (cat. no. 12750) seem also to be immature individuals of *M. americanum*. Similar specimens occur in the Torino Herbarium (TO - no. 632, photo srh!).

In describing *Malva ovata*, Cavanilles cited plants observed by Commerson, and specimens of Thouin. There are no specimens of the plant in the Thouin Herbarium (SBT), but a Thouin herbarium specimen bearing this name and a reference to the original publication was found at Copenhagen (C). This specimen is here chosen as lectotype. In the Cavanilles' Herbarium (MA) is a sheet with two specimens, one of which is a young specimen of *Malvastrum americanum* said to be from Brazil. The other specimen, not a *Malvastrum*, is from the Cape of Good Hope, not a locality cited by Cavanilles. Also in the Cavanilles Herbarium are two specimens labeled *Malva polystachya*. These are ineligible to be considered as lectotypes under this name as they are dated 1828, 40 years after the original description. Cavanilles' illustration agrees closely with a Lagasca specimen at Geneva grown at the Madrid Botanic Gardens and was likely based on this material.

The earlier botanists generally did not provide enough descriptive information to distinguish *Malvastrum americanum* from *M. corchorifolium*. To compound the nomenclatural problem, *Malva americana* Linnaeus was, beginning with Cavanilles (1786), often misapplied to *Malvastrum coromandelianum*. Since several of the early type specimens have not been found, some doubt concerning application must be attached to certain names in *Malva* published

before 1849. I have listed the synonyms known or suspected by me to belong in *M. americanum* above. This species is one of the few with a cordate leaf base and dense vesture and so it can often be separated from *M. corchorifolium* in early descriptions by these characters. Specimens of the two species can be readily distinguished from one another by both the distinctive vesture characters and the morphology of the reproductive parts at maturity.

In an earlier section I have put forth the hypothesis that *Malvastrum americanum* is indigenous to Australia where mericarp-number and variation as well as stamen-number do not always fit within the variation found in American populations. In many Australian specimens, the endoglossum, so conspicuous in the mericarps of American plants, is absent or highly reduced. One group of specimens have unusually elongated mericarps as well (Fig. 27) and, if it were not for a complete series of transitional forms, these could be considered a distinct variety. The extreme forms are found in a zone of selenium-contaminated soils (according to label data) and resemble, to an extent, the mericarps of *M. chillagoense*.

REPRESENTATIVE SPECIMENS: **United States.** FLORIDA: Lee Co., eastern Sanibel Island, *Brumbach* 7026 (FLAS, NY); TEXAS: Cameron Co., Laguna Atacosa Nat'l. Wildlife Refuge, *Board* 1098 (pf); Southmost, Brownsville, *Hill* 6054 (GH, MO, NY, pf, SMU, srh); Hidalgo Co., S of Donna, *Cameron* 107 (F, TEX); Kleberg Co., Laguna Larga, *Johnston* 53175.28 (TEX); Nueces Co., Flour Bluff, Oso Bay, *Hill* 8093 (BRI, CTES, F, GH, MO, NY, pf, SMU, srh, TAES, TEX, US, VT, WIS); Willacy Co., Sauz Ranch near headquarters, *Johnston* 53175.31 (TAES, TEX).

Mexico. CHIAPAS: Mun. Tuxtla Gutiérrez, *Breedlove* 19992 (DS, MICH, pf); COLIMA: Manzanillo, *Palmer* 1040 (CAS, G, GH, NY, US); GUERRERO: Distr. Coyuca, Pungarabato, *Hinton et al.* 7285 (F, K); JALISCO: Río San Pedro, *Gentry et al.* 19553 (TEX, US); MÉXICO: Temascaltepec and Pericones, *Hinton* 2958 (G, GH, K, NY, US); MICHOACAN: Tacupa, Huetamo, *Hinton* 5623 (K, US); NUEVO LEON: Monterrey, *Pringle* 1938 (CAS, F, G, GH, K, MICH, NY, PH, RSA, UC, US, VT); OAXACA: N of Jayacatlan along road to Nacaltepec, *Breedlove* 35899 (CAS, pf, TEX); 25 km N of Juchitan, *Koch et al.* 78290 (pf); SAN LUIS POTOSÍ: 2-3 mi W of El Naranjo, *King* 3981 (F, NY, TEX, UC, US); SINALOA: Mazatlán, *Ortega* 736 (GH, K, POM); TAMAULIPAS: El Rosario near Marmolejo, *Bartlett* 10865 (DS, GH, MICH, TEX, US); VERACRUZ: Laguna de la Mancha, Actopan, *Dorantes et al.* 5369 (pf); S of Tampico between K 125-130, *Percival s.n.* (pf); Cerro Gordo near Salto del Río Grande, *Ventura* 2622 (DS, F, MICH, NY, pf, TEX).

Guatemala. CHIQUIMULA: between Chiquimula and Santa Rosalía, *Molina & Molina* 25145 (NY); ESCUINTLA: near San José, *Standley* 64203 (F, NY); GUATEMALA: Sanarate, *Kellerman* 6670 (F, US); JUTIAPA: Jutiapa, *Standley* 75723 (F, G); RETALHULEU: Champerico, *Standley* 66645 (F); SANTA ROSA: near Cuilapa, *Standley*

78535 (F); ZACAPA: Zacapa, *Standley* 74380 (F); **El Salvador**. AHUACHAPÁN: near Achuapán, *Standley* 20027 (GH, NY, US); SAN MIGUEL: Laguna Lomega, *Standley* 21005 (GH, US); **Honduras**. SWAN ISLANDS: *Nelson* 100 (GH); COPÁN: near Quebracho, *Molina* 24657 (NY); CORTES: Río Chamelecon, *Molina* 11644 (F, NY, US); EL PARÁISO: between El Paraíso and Villa Humada, *Molina* 27201 (F, MICH, US). **Nicaragua**. BOACO: Potrerillas, Rte. 7, *Seymour* 2362 (F, GH, MO, SMU, UC); CHONTALES: 5 km SE of Juigalpa, Rte. 7, *Hamblett* 1614 (GH, MO, NY, SMU, UC, WIS); ESTELÍ: 3 km from Condega, *Molina* 23201 (DS, NY); LEÓN: Nagarote, *Seymour* 2385 (GH, MO, SMU); MANAGUA: east shore of Lago de Managua, N of Tipitapa, *Fryxell* 2861 (pf); MATAGALPA: 5–10 m W of Matagalpa, *Williams et al.* 23805 (F, G, TEX); NUEVA SEGOVIA (Madriz): Finca El Chile, 10 km from Somoto, Hwy. to border, *Molina* 27315 (F, MICH); RIVAS: La Virgen, Rte. 16 at K 136, *Zelaya* 1242 (GH, MO, NY, SMU, UC, WIS). **Costa Rica**. GUANCASTE: La Cruz, *Pittier* 2744 (US). **Panama**. COCLE: 10 mi E of Nata, Río Grande, *Tyson* 5249 (MO); DARIEN: vicinity of Yape, Río Tuira, *Allen* 4299 (G, GH, NY); HERRERA: banks of Río Santa Maria, *Burch et al.* 1189 (GH, K, MO, NY, UC, US); LOS SANTOS: 5 mi S of Pocri, *Croat* 9740 (MO); PANAMA: Panama, *Porterfield s.n.* (NY); CANAL ZONE: near Playa Venado, *Wilbur & Teeri* 12972 (DS, GH, MICH, NY, TEX).

Cuba. HABANA: Havana, *Boldo s.n.* (F); LAS VILLAS: Santa Clara, Ranchuelo, *Cuesta* 605 (NY); MATANZAS: valley of the Canimar, *Britton et al.* 365 (NY); ORIENTE: Guantanamo Bay, *Britton* 1916 (F, NY, US). **Haiti**. GONAVE ISLAND: Anse Galette, *Leonard* 3113 (US); TORTUE ISLAND: tableland west of La Vallée, *Leonard & Leonard* 11260 (BH, BKL, US); NORD-OUEST: Bassin Bleu, *Leonard & Leonard* 14787 (US); NORD: Mt. La Mine, *Leonard* 7347 (GH, US); ARTIBONITE: Gros Morne, *Leonard* 9978 (US); OUEST: S of Port-au-Prince, *Leonard* 5265 (NY, US); SUD: Miragoane, *Eyerdam* 461 (GH, US). **Dominican Republic**. AZUA: valley of Neiba, Guaragua, *Howard & Howard* 8358 (GH); BANÍ: La Tabla, *Liogier* 17551 (NY, US); BARAHONA: *Fuertes* 264 (G, GH, NY, US); BENEFactor: San Juan, San Juan Santiago, *Howard & Howard* 9286 (GH); PUERTO PLATA: Puerto Plata, Lojas, *Jiménez* 2506 (US); SAN CRISTÓBAL (Trujillo): Najayo, near San Cristóbal, *Augusto* 447 (NY); SANTIAGO: Santiago, Valle del Cibao, *Ekman* 16141 (B, F, US); SANTO DOMINGO: Haina, *Faris* 134 (US). **Puerto Rico**. GUAYAMA: Aguirre (Salmar), *Goll* 558 (US); MAYAGUEZ: Guayanilla, *Britton & Shafer* 1855 (F, NY, US); PONCE: Coamo Springs, *Britton et al.* 6342 (G, NY); SAN JUAN: Distr. Bayamón, Bayamón, *Sintenis* 1080 (G, MO, NY, UC, US); CULEBRA ISLAND: *Britton & Wheeler* 213 (F, NY, US); MONA ISLAND: Sardineira, *Britton et al.* 1659 (NY, US); VIEQUES ISLAND: Isabel Segunda, *Shafer* 2445 (CAS, NY, US). **Virgin Islands**. ST. CROIX: Mary's Fancy, *Britton* 203 (NY); ST. THOMAS: *Eggert* 282 (GH, NY, US); TORTOLA: Elizabeth Beach, *D'Arcy* 412 (C, GH); VIRGIN GORDA: *Fishlock* 59 (NY). **Jamaica**. CORNWALL: Westmoreland Parish, Bluefields, *Britton* 1605 (NY); MIDDLESEX: Manchester Parish, Mandeville, *Norman* 78 (MO); SURREY: Kingston Parish, Kingston, *Britton & Hollick* 1745 (NY). **St. Martin**. *Boldingh* 2346 (NY). **St. Berthélemy**. Gustavia, *Questel* 10 (NY). **St. Eustatius**. Orangestad, *Shiffers* 3864 (GH). **Antigua**. Parry's Hill, *Box* 917 (F, GH, MICH, MO, pf, US). **Guadeloupe**. DÉSIDRADE: *Duss* 3211 (F, GH, MO, NY, US); GUADELOUPE: Hautence de Bouillante, *Stehlé* 105 (NY); MARIE-GALANTE: *Stehlé* 476 (NY). **Martinique**. Marin to Vauchi, *Duss* 858 (NY). **St. Lucia**. Cap Estate, *Sturrock* 336 (GH). **St. Vincent**. *Smith & Smith* 1597 (NY). **Grenadines**. GRENADA: *Bailey* 427 (BH); UNION ISLAND: Chatham Bay area, *Howard*

11017 (NY). **Barbados.** St. George, *Botanic Station Herbarium* 344 (F, NY, US). **Tobago.** between Scarborough & Friendship, *Druce s.n.* (OXF). **Trinidad.** CHACACHACARE ISLAND: *Cowan* 1113 (US); GASPAREE ISLAND: *Britton* 472 (GH, NY, US); MONOS ISLAND: *Graf* 13 (NY); TRINIDAD: St. Joseph Road near the Quarry, *Broadway* 7054 (G, MO, PH). **Curaçao.** near Williamstadt, *Britton & Shafer* 2959 (NY, US). **Aruba.** *Boldingh* 7012 (NY).

Venezuela. ANZOATEGUI: Guanta, *Cardona* 576a (US); ARAGUA: Maracay, *Croat* 21340 (MO, pf, US); CARABOBO: between Puerto Cabello and Las Trincheras, *Alston* 5725 (BM, NY, U); DISTRITO FEDERAL: Cabo Blanco, 4 mi. W of La Guaira, *Pittier* 10233 (BH, GH, NY, US); FALCÓN: Adicora de Paraguaná, *Tamayo* 1079 (US); LARA: near Barquisimeto, *Alston* 6381 (BM); MÉRIDA: between Mérida and La Azulita, *Bascope* 23 (GH); MIRANDA: near Sta. Lucía, Hacienda El Volcán, *Pittier* 8280 (BH, DS, F, GH, MO, POM, UC, US); PORTUGUESA: Píritu, *Trujillo* 8683 (F); TACHIRA: Cristóbal Colón, *Broadway* 161 (GH, NY, US). **Colombia.** ANTIOQUIA: Dabeiba, *Barkley & Gutiérrez* 1807 (NY); ATLÁNTICO: Puerto Columbia, Miramar, *Dugand* 4010 (US); BOLIVAR: Cartagena, *Heriberto* 218 (NY, US); BOYACÁ: Soatá, *Cuatrecasas* 1032 (F, US); CUNDINAMARCA: Girandot, *Rusby & Pennell* 157 (F, GH, MO, NY, US); HUILA: Río Ambicá, *Fosberg* 19336 (NY, US); MAGDALENA: Santa Marta, *Smith* 483 (BR, DAO, F, G, MICH, MO, NCU, NY, PH, RSA, TEX, U, US, VT, WIS); NARIÑO: road to Puerto Delicias, above Río Pureto, *Ewan* 15956 (CAS, US); NORTE DE SANTANDER: La Esmeralda, *Killip & Smith* 20944 (GH, NY, US); SANTANDER: Bucaramanga, *Araque & Barkley* 258 (NY, UC); VALLE DEL CAUCA: 9.1 km below Dagua, *Hutchinson & Wright* 3284 (MICH, MO, NY, UC, US). **Ecuador.** MANABI: Bahía de Caraquez, *Anthony & Tate* 106 (US); **Galápagos.** SAN CRISTÓBAL ISLAND (CHATHAM): western coast, *Schimpff* 168 (BKL, CAS, G, MO, NY, U); Wreck Bay, *Stewart* 2011 (CAS); SANTA CRUZ: trail from Academy Bay to Bella Vista, *Wiggins* 18471 (BH, DS). **Peru.** JUNÍN: Chacapoyas, *Mathews s.n.* (G, GH, OXF). **Bolivia.** COCHABAMBA: Tunari, *Kuntze s.n.* (NY); SANTA CRUZ: Angostura, *Steinbach* 340 (F, GH, MICH, NY, U, UC, US). **Brazil.** BAHIA: Ilheus, *Herb. Martius* 1010 (F, G, GH, K, MO, NY, OXF, U, US); CEARÁ: between Río Berbeiro and Crato, *Castellanos* 33403 (K, NY); GUANABARA: Río de Janeiro, *Banks & Solander* 1768 (MO); MATO GROSSO: Mun. Miranda, near Río Miranda, Hwy. 262, *Hatschbach* 29469 (UC, US); MINAS GERAIS: Bon Cavati, BR-4, *Silva-Santos* 28017 (K, MO, NY); PARANÁ: Mun. Guaira, Porto Novo, *Hatschbach* 8074 (US); RÍO DE JANEIRO: Araruama, *Sucre* 774 (UB, US); SÃO PAULO: Campinas, Fazenda Sete Quedas, *Ganzaroli* 6249 (CAS, UC). **Argentina.** CHACO: Casa Lata, along the Río Paraguay, *Rojas* 11766 (BR); CORRIENTES: Tacombi, *Hicken* 324 (NY); FORMOSA: Guaycole, *Jorgensen* 3165 (GH, MO, U, US); MISIONES: Posadas, near the Alto Parana River, *Ekman* 132 (MO, NY). **Paraguay.** Sapucaí, *Hassler* 11838 (C, F, G, GH, K, MO, NY, US). **Cape Verde Islands.** SANTIAGO ISLAND: Porto Praia, *Wright s.n.* (US); SÃO NICOLÃO ISLAND: Coelho, *Barbosa* 7218 (MO).

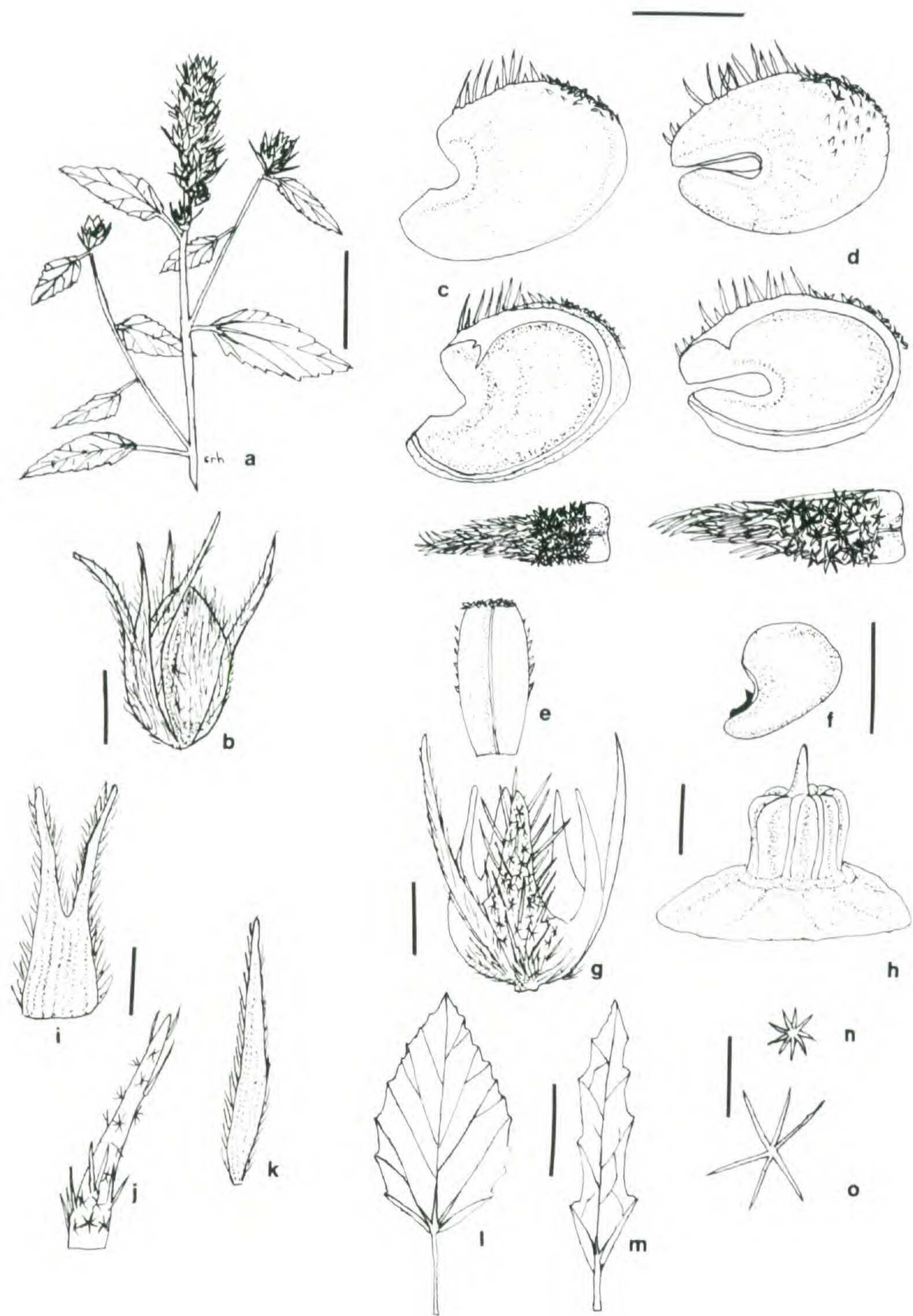
China: FUKIEN: *Chung* 6530a (NY). **Australia.** NEW SOUTH WALES: Nyngan, *Maiden s.n.* (F, G, GH, POM); NORTHERN TERRITORY: 11 mi NW of Alexandria, *Chippendale* 7143 (BRI, K); NORTHWEST AUSTRALIA: Ashburton River, *von Mueller s.n.* (CAS); QUEENSLAND: S. Kennedy Distr., 3.5 mi ENE of Avon Downs station, *Adams* 1058 (BRI); Gregory North Distr., Cloncurry, *Blake* 8894 (BRI); Burke Distr., between Richmond and Maxwellton, *Everist* 3006 (BRI, NY, US); Gregory North Distr., Duchess, *Hubbard* 7382 (BRI); Charters Towers, *Michael* 1287 (BRI); 10 km SE of

Charleville, *Purdie & Boyland* 35 (BRI); Burke Distr., Granada, *Sillar* 2 (BRI); SOUTH AUSTRALIA: Mt. Lyndhurst, *Koch* 83 (G, US); Northwest plains, 40 km N of Mt. Eba on Stuart Hwy. Watercourse, Sloanes Bore Out Station, *Weber* 2972 (NY); WESTERN AUSTRALIA: 34 mi SSE of Turner River Station, *Perry* 2416 (BRI, US). **Indonesia.** SUMBA ISLAND: Waingapu (Nambeso), *Expeditie Soemba* 37 (BRI); TIMOR: *Riedlé s.n.* (K).

Also reported from India, Burma, and in wool waste in England.

- 4b. ***Malvastrum americanum*** (Linnaeus) Torrey var. ***stellatum***
 S. R. Hill, *Brittonia* 32(4): 464. 1980. Fig. 30, 31.
 TYPE: AUSTRALIA. Queensland: Middle Percy Island, 87 mi SE of Mackay, 24 Apr 1956, *M. Lazarides* 5606 (HOLOTYPE; BRI!; ISOTYPES; K! US!).

Annual or suffrutescent perennial herb (0.2) 0.4–1 (2) m tall, bushy in age; *main stem* 4–7 mm (or more?) diam at base; *branches* usually 10–30 cm long at maturity, vesture of stem rough in texture, canescent with dense overlapping tufted to appressed sessile (4) 6–7 (8)-rayed stellate hairs 0.2–0.8 mm diam tardily shed; *cotyledons* unknown; *stipules* (3) 5–8 mm long $\times$ 0.6–1.0 mm wide, subfalcate, narrowly lanceolate to subulate; petioles (3) 5–20 (30) mm long; *blades* 2.3–5 (7) $\times$ longer than the petioles on main stem leaves, (20) 45–60 (75) mm long $\times$ (9) 20–30 (35) mm wide, average midstem blade 1.6–2.5 $\times$ longer than wide to 4.5 $\times$ longer than wide in upper leaves, ovate to lanceolate, unlobed or infrequently 3-lobed 1/4 to 1/2-way to the truncate rounded to wide-cuneate base, apex acute to acuminate, margin dentate with 2.5–3.5 (5) teeth/cm, vesture of the adaxial surface of generally overlapping 5–6 (8)-rayed stellate hairs infrequently (*Johnson 1376*) mixed with simple or 2-rayed hairs, 0.8–1.0 mm diam, abaxial surface sparsely to densely pubescent with similar 5–12-rayed hairs; *flowers* overlapping in terminal congested or loosely flowered spikes 2–8 cm long, the first 1–2 (5) infrequently solitary axillary, each flower subtended by a bifid *floral bract* 5–7 mm long $\times$ 1.5–2 mm wide divided 1/3 to 1/2 its length; *pedicels* up to 3 mm long to less than 0.5 mm on flowers in spikes, not increasing in fruit; *involucel* of 3 long-acuminate to subulate bracteoles (5) 7–9 (10) mm long $\times$ 0.5–1.0 mm wide, generally exceeding the calyx lobes by 1–2 (3) mm in flower, adnate to the calyx in the basal 0.5–1 mm; *calyx* united 1/3 to 1/2 its length, 5–6 mm from pedicel to lobe increasing to 6–9 mm in fruit, campanulate in flower and fruit and indistinctly angled, abaxial



surface densely pubescent or hirsute with apically directed simple to 5-rayed stellate hairs 1.0–1.8 mm diam with minute 6–10-rayed stellate hairs 0.1–0.7 mm diam, with a few minute arachnoid simple or stellate hairs at apex and at margins to sinus; *corolla* ca. 10 mm diam and wide-campanulate to rotate, pale orange-yellow, petals obovate and briefly asymmetrically lobed, ca. 6 mm long $\times$ 4 mm wide, exceeding the calyx by 1–2 mm, claws ciliate with tufted simple or stellate hairs 0.5–0.8 mm long; *androecium* with 18–25 (30) stamens, filament tube 1.5–2.0 mm long, pubescent with delicate generally 6-rayed stellate hairs 0.5–0.7 mm diam, free portion of filaments 0.9–1.0 mm long; *gynoecium* with 9–11 (13) carpels, style branching 2–2.5 mm above the columella, each branch terminated by a slightly expanded hemispherical papillate stigma, these generally exserted 0.5–1.0 mm beyond the anthers and recurved at flower wilt; *schizocarps* 4.5–5.5 mm diam; *mericarps* 9–11 (13), 1.6–2.0 mm in height $\times$ 2.0–2.5 mm in length $\times$ 0.7–0.8 mm wide, distinctly separate from one another, unornamented or with a minute mucro less than 0.1 mm long, faces inconspicuously ribbed, distal-basal surface with a generally inconspicuous raised medial line, distal-apical surface with a shallow sulcus, vesture of apical surface distinctive, with a proximal zone of erect simple hairs ca. 0.5 mm long and a dense medial-distal zone of appressed 6–8-rayed stellate hairs 0.2–0.3 mm diam giving the fruit a frosted appearance, lateral surfaces sparsely pubescent with minute stellate or simple hairs, pericarp chartaceous over the seed and firm to ligneous elsewhere, infrequently partially dehiscent at the base and often dehiscent at the proximal-apical margin, the valves not separating, endoglossum 0.1–0.4 mm long set ca. 0.5 mm distal to

Figure 30. *Malvastrum americanum* var. *stellatum*. a. Habit, scale = 5 cm. b. Flower bud, scale = 2 mm. c. Mericarp, lateral, internal and apical views, scale = 1 mm. d. Mericarp, lateral, internal and apical views. e. Mericarp, distal view, scale = 1 mm. f. Seed, scale = 1 mm. g. Calyx in fruit (vesture of one lobe only), scale = 2 mm. h. Columella and carpocrater, scale = 0.5 mm. i. Floral bract, adaxial surface, scale = 2 mm. j. Stipule, abaxial surface, scale = 2 mm. k. Bracteole, adaxial surface, scale = 2 mm. l. Midstem leaf, scale = 2 cm. m. Midstem leaf, scale = 2 cm. n. Distal mericarp hair, scale = 0.5 mm. o. Stem hair, scale = 0.5 mm. (a–b, g–k, and o from *Lazarides* 5606; c from *Blake & Everist* 3260; d,f,n from *Johnson* 2116; e from *Lehler & Knowles* s.n.; l from *Johnson* 1377A, m from *Johnson* 1376).



the proximal surface; *seeds* ca. 1.5 mm in height $\times$ 1.5 mm in length $\times$ 0.6 mm wide; *chromosome number*: not known; *pollen* 41–61 (56) μ m diam, *echinae* ca. 4 μ m, *apertures* 6–9.

DISTRIBUTION. (Fig. 32) Australia, in Queensland and New South Wales, most frequent in Leichhardt District, at altitudes of ca. 150–300 meters.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Collection data indicate that this variety flowers primarily from January until April and less frequently into May and July under favorable conditions. The exerted stigmas suggest outcrossing potential, but the flowers self-pollinate as the stigmas later recurve.

DISCUSSION. This variety is representative of one of the morphological extremes of *Malvastrum americanum* found in Australia. It is more easily recognized as a distinct entity than the others, and may be indigenous to eastern Australia, rather than an ecological variant of a more recently introduced population. The zonation of the apical vesture, the occurrence of dense appressed stellate hairs in that region, in combination with the narrower leaves, usually more loosely-flowered spikes, and more conspicuous bracts and bracteoles serve to distinguish this variety from var. *americanum*.

SPECIMENS EXAMINED: **Australia.** NEW SOUTH WALES: Brewarrina, *Boorman s.n.* (BRI); Hungerford to Brindigabba, *Boorman s.n.* (US); Lightning Ridge, *Constable 19080* (K, pf); 10 km SSW of Camden, Razorback Range, *Coveny et al. 7485* (K); QUEENSLAND: Brisbane, *Bailey s.n.* (MO); Moreton Distr., Toowona, Brisbane, foot of Mt. Coottha, *Blake & Everist 3260* (BRI); Leichhardt Distr., Minerva, *Blake 7948* (BRI); Rockhampton north, State School, *Cleminson s.n.* (BRI); Darling Downs Distr., Toowoomba, *Clydesdale 88* (BRI); Rockhampton, *Dietrich 853 Dietrich s.n.* (US); Blackwater, E of Emerald, *Francis s.n.* (BRI); Imbil, *Fraser 180* (BRI); Leichhardt Distr., 3 mi W of Comet, *Johnson 1376* (BRI, GH) and *1377A* (BRI); Leichhardt Distr., Hillview, 3 mi W of Injune, *Johnson 2116* (BRI); Gympie, *Kenney s.n.* (BRI); Moreton Dist., Hamilton, *Lebler & Knowles s.n.* (BRI); Leichhardt Distr., 12 mi S of Nebo Township, *Story & Yapp 131* (BRI); Maranoa Distr., Mucadilla, *Trenouth 20* (BRI); Mitchell Distr., Gartmore, Tambo, *Wilson 5* (BRI).

5. ***Malvastrum chillagoense*** K. Domin, *Biblioth. Bot.* **89**: 386. 1928.

TYPE: AUSTRALIA. Queensland, Cook District, on bare limestone hills, Lion's Head Bluff near Chillagoe, February, 1910. *K. Domin 6499* (LECTOTYPE: PR!). Fig. 33, 34.

Suffruticose, perennial herb 0.3–3.5 m tall, becoming bushy; *main stem* 3–4 mm diam at base, somewhat woody; *branches* up to 15–25 cm long; *vesture* of somewhat loose and not appressed stellate hairs with 6–8 rays, 0.1–1.2 mm diam; *cotyledons* unknown; *stipules* 2–3.5 mm long $\times$ 0.3–0.8 mm wide, linear to narrowly lanceolate on early growth; *blades* (1.5) 3–4 $\times$ longer than the petioles, (15) 25–40

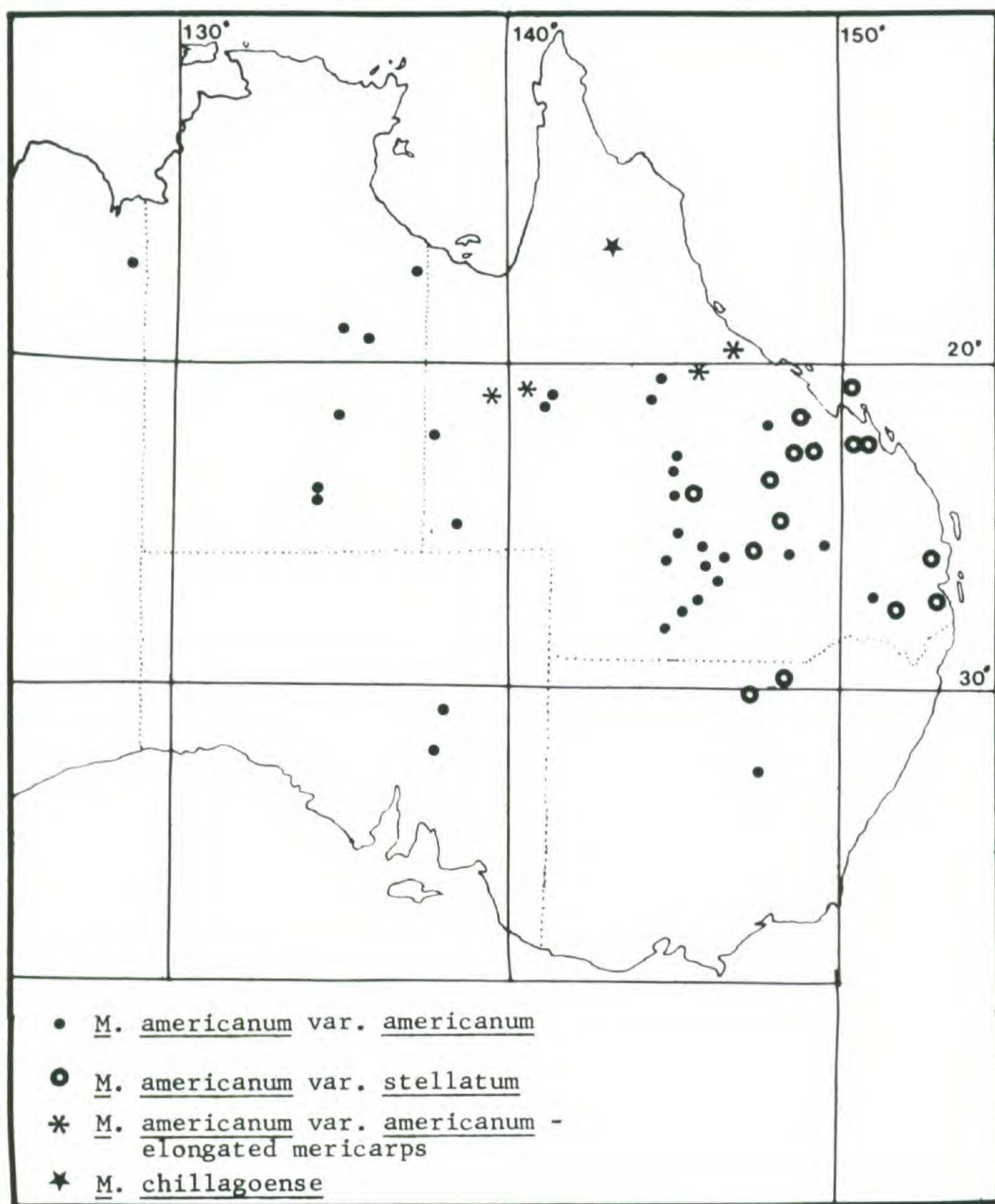


Figure 32. Distribution of *M. americanum* and *M. chillagoense* in Australia.

(1.7) $2-2.2\times$ longer than broad, ovate to ovate-lanceolate, upper leaves narrowest, unlobed, base rounded to broadly cuneate, apex acute, margin dentate with 4–5 teeth/cm, vestiture of adaxial surface of somewhat dense 6–8-rayed stellate hairs similar to those of the stem, abaxial pubescence of dense similar 10–12-rayed stellate hairs completely obscuring the surface; *flowers* in axils of leaves, later borne in axils of bifid bracts, inflorescence basically an elongated or contracted raceme with reduced spicate floriferous branchlets arising in upper leaf and floral axils; *floral bracts* 3–5 mm long $\times$ 1–1.5 mm wide divided $1/3$ to $1/2$ their length; *pedicels* 1–2 mm long, not increasing in fruit; *involucl* of 3 narrowly lanceolate to linear bracteoles 3–4 mm long $\times$ 0.3–0.5 mm wide, free of the calyx; *calyx* united $1/4$ to $1/3$ its length, campanulate, 5–6 mm long accrescent in fruit to 6–8 mm, lobes narrowly triangular, acuminate, erect in flower and fruit, 3–5 mm long $\times$ 1.2–2.1 mm wide, externally tomentose with stellate 6–8-rayed hairs less dense towards apices with a few marginal simple or 2–3-rayed hairs 0.1–1.0 mm diam, lobes arachnoid-pubescent within on upper $1/2$; *corolla* yellow or pale orange-yellow, petals asymmetrically bilobed, 6 mm long $\times$ 4.5–5 mm wide, exceeding the calyx by 2 mm and campanulate, claw pubescent at the base and margins with rather sparse fine hairs; *androecium* with (20) 23–24 stamens distinctly arranged in 5 rows in bud, filament tube 2.0 mm long, pubescent with sparse fine 3–6-rayed stellate hairs 0.2 mm diam similar in texture to those of the petal claws, free portion of filaments 0.8–1.0 mm long; *gynoecium* with 7 (8) carpels, style 7 (8) branched 2 mm above the columella, each branch with a terminal non-enlarged stigma not exceeding the stamens and generally reflexed in specimens; *schizocarps* 3.5–4.5 mm diam; *mericarps* 7 (8), 1.9 mm in height $\times$ 1.2 mm in length $\times$ 1 mm in width at the base narrowing toward the apex, unornamented, lateral faces with ribs extending to the thickened distal surface, proximal portion of lateral surface thin over the seed, distal surface with a conspicuous raised medial line, vestiture hirtellous, of minute simple hairs 0.2–0.3 mm long restricted to the proximal portion of the apical surface or scattered on the apical margins of the lateral faces, pericarp indehiscent, endoglossum absent; *seeds* 1.2 mm in height $\times$ 1.8 mm in length $\times$ 0.8–1.0 mm wide; *chromosome number*: not known; *pollen* diam 48.6–64 (57.4) μm , echinae 2.6–3.8 μm , apertures 6–8, usually 7.



DISTRIBUTION. (Fig. 32) Known only from the type locality, limestone bluffs in the vicinity of Chillagoe, Cook District, northern Queensland, Australia, elevation 300–400 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. The specimens examined were in flower and with young fruits in February and March, the flowering apparently continuing into April (local autumn). The stigma positions suggest that self-pollination is frequent. The daily flowering time is not known.

DISCUSSION. In several respects, *Malvastrum chillagoense* resembles *M. americanum* var. *americanum* particularly in populations of the latter in north-central Queensland that have a reduced endoglossum, mericarp hairs restricted to the proximal portion of the apical surface, and asymmetrical mericarps (cf. Fig. 27). *Malvastrum chillagoense* differs from these, however, in the fewer and smaller mericarps with their conspicuously ribbed lateral faces as well as by the very different inflorescence structure. Retention of certain primitive characters such as the conspicuous raised medial line of the mericarp, the free bracteoles, the less specialized vesture (particularly on the calyx), and the fairly high frequency of solitary axillary flowers suggest that the ancestor of this species was a more primitive *Malvastrum* and probably not the specialized *M. americanum* as it exists today.

SPECIMENS EXAMINED: **Australia.** QUEENSLAND, Cook District, barren limestone slopes of Lion's Head Bluff near Chillagoe, *Domin* 6497 (PR- syntype); among boulders on rugged limestone ridge ca. 1200 ft, Chillagoe, *Blake* 13528 (BRI, K).

Section 4. *Tomentosum*

Figure 33. *Malvastrum chillagoense*. a. Habit, scale = 5 cm. b. Flower bud, scale = 2 mm. c. Petal, scale = 2 mm. d. Pistil, scale = 2 mm. e. Stamens, styles, and stigmas, scale = 2 mm. f–h. Mericarp, lateral, distal, apical views, scale = 1 mm. i. Mericarp, internal view, scale = 1 mm. j. Fruit, apical view (vesture of calyx not indicated), scale = 2 mm. k. Seed, lateral view, scale = 1 mm. l. Calyx in fruit, lateral view, scale = 2 mm. m. Columella and carpocrater, scale = 0.5 mm. n. Floral bract, scale = 2 mm. o. Stipule, scale = 2 mm. p. Bracteole, scale = 2 mm. q. Leaves, from midstem and branch apex, scale = 2 cm. r. Stem hair, scale = 0.5 mm. s. Calyx hairs, scale = 0.5 mm. (a–b, j–k, m from *Blake* 13528, c–i, l, n–s from *Domin* 6499).

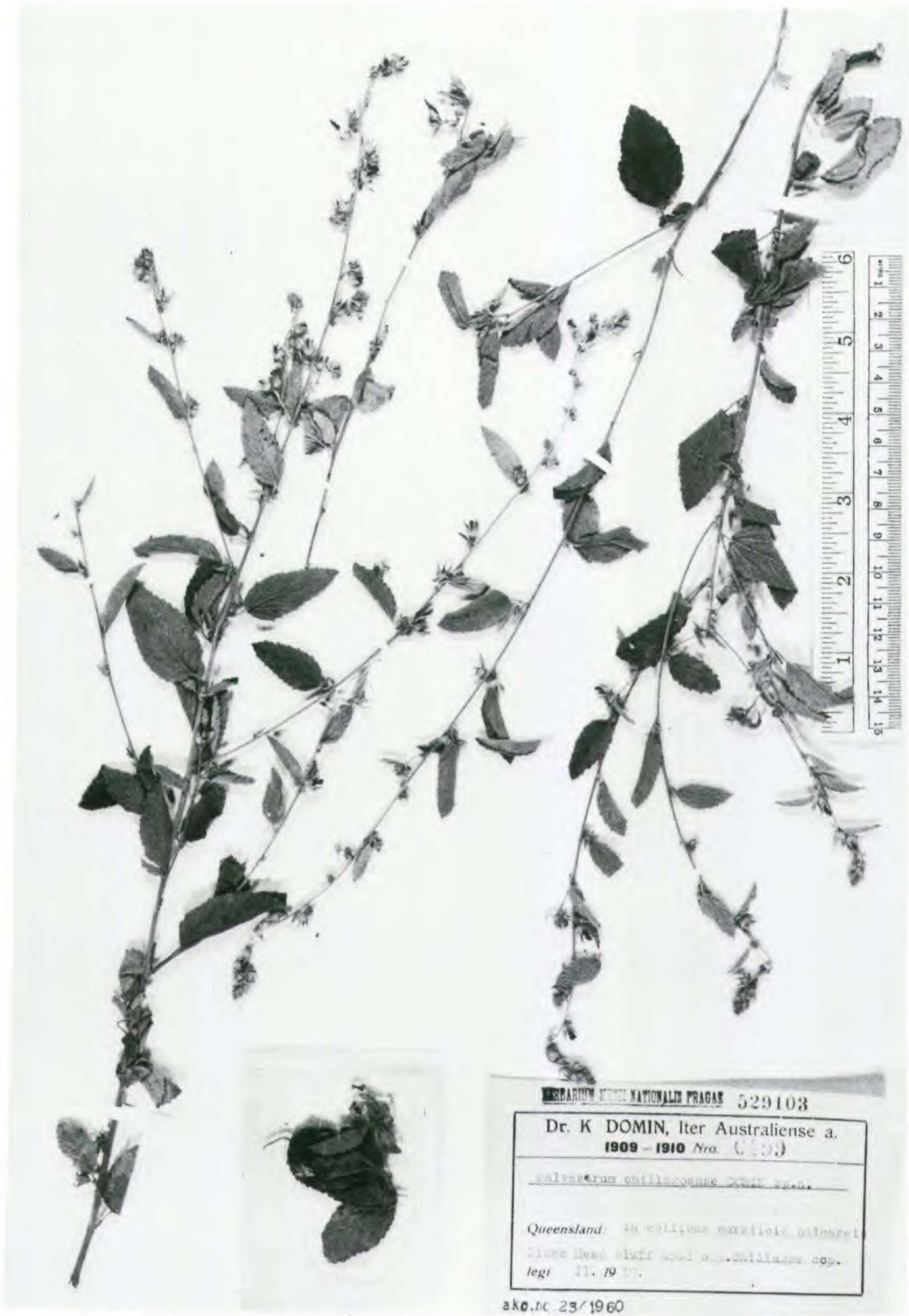


Figure 34. *Malvastrum chillagoense* (lectotype).

Malvastrum sectio **Tomentosum** S. R. Hill, *sect. nov.*

Carpella matura 9–13, indehiscentia vel margine proximali-apicali dehiscentia, superficie apicali pilis stellatis et simplicibus vel stellatis solis vel glabra, muris lateralibus pericarpium crassis vel coriaceis, cuspidibus 2 distali-apicalibus (0.1–) 0.5–1 (–2) mm longis et cuspidem vel interdum mucrone unico proximali-apicali 0.05–0.5 (–1.0) mm longo ornata, marginibus pericarpium angulatis, endoglosso praesenti vel nullo; stamina 25–75, columna staminali pubescenti; flores primo solitarii axillares, demum in racemis terminalibus vel in spicis congestis axillaribus vel terminalibus; bracteolae involuelli basi ad calycem adnatae vel liberae; bractaeae florales bifidae praesentes; pili caulini raro stipatati; pollinis grana aperturis 5–10. Typus: *Malvastrum tomentosum* (L.) S. R. Hill.

The racemose inflorescences, partially dehiscent or indehiscent firm or leathery walled bi- or tricuspidate mericarps, bifid floral bracts, pubescent filament tube, and 5–10 aperturate pollen characterize the section *Tomentosum*.

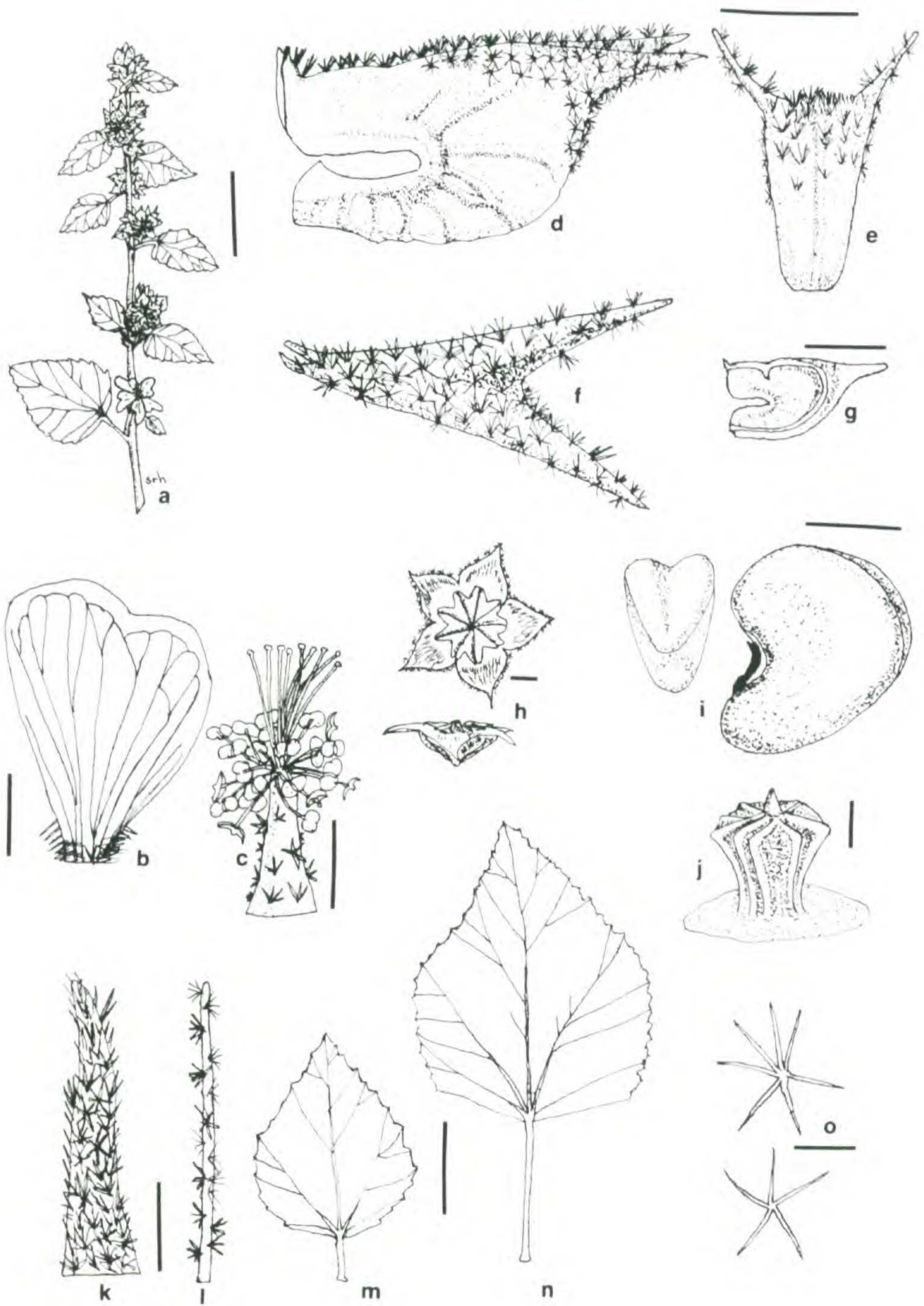
6a. **Malvastrum tomentosum** (Linnaeus) S. R. Hill subsp. **tomentosum**, *Brittonia* 32(4): 466. 1980. Fig. 35, 36.

Malva tomentosa Linnaeus, Sp. Pl. 2: 687. 1753. TYPE: specimen grown at Hortus Upsaliensis, seeds from de Jussieu (LECTOTYPE: LINN No. 870.2).

Malva scoparia L'Héritier, Stirp. Nov. 53, f. 27. 1786, non Jacquin, 1787. TYPE: PERU. Lima: fields at Lima, *Dombey s.n.* (HOLOTYPE: P, fragment at US!; ISOTYPES: BM (no. 95)!, F (no. 678)!, MA (no. 678)). *Malvastrum scoparium* (L'Hérit.) A. Gray, Bot. U.S. Expl. Exped. 1: 147, in textu. 1854. *Sphaeralcea scoparia* (L'Hérit.) Tidestrom, Proc. Biol. Soc. Wash. 48: 41. 1935, excl. specim.

Malva scabra Cavanilles, Diss. 5: 281, t. 138, f. 1. 1788. TYPE: cultivated at Hortus Matritensis from seeds from arid regions of Huánuco, Perú, *Cavanilles (?) s.n.* (HOLOTYPE: MA (photo-US); ISOTYPES: F!, MA (photo-F), MO!, PH!). *Malvastrum scabrum* (Cav.) A. Gray, Bot. U.S. Expl. Exped. 1: 147. 1854, excl. specim. et descr. *Malvastrum scabrum* var. *genuinum* E. Hassler, Feddes Repert. Spec. Nov. Regni Veg. 12: 366. 1913.

Malva waltherifolia Link, Enum. Plant. 209. 1822. TYPE: "Hab. in Java." Link's Berlin types were lost. Ulbrich (1915) examined Link's type, and also cited a specimen in the Bernhardt Herbarium (MO!) which is *Malvastrum tomentosum*. Specimens in the Balbis Herbarium (TO) dated 1823 from Leiden and a specimen at PH! may be isotypes of Link's species. *Anoda waltherifolia* (Link) K. Schumann ex Ulbrich, Feddes Repert. Spec. Nov. Regni Veg. 13: 510. 1915, pro syn., nom. nud., excl. specim. *Malvastrum waltherifolium* (Link) Ulbrich, Feddes Repert. Spec. Nov. Regni Veg. 13: 510. 1915.



Sida depressa Benth, Bot. Sulphur: 69. 1844. TYPE: Isle of Puná near Guayaquil, H.M.S. Sulphur Expedition, *Sinclair s.n.* (HOLOTYPE: K!, ISOTYPES: GH! K!). *Malvastrum depressum* (Benth) H. K. Svenson, Amer. J. Bot. 33: 465. 1946.

Malvastrum guaraniticum E. Hassler, Feddes Repert. Spec. Nov. Regni Veg. 12: 264. 1913. TYPE: BRAZIL: Mato Grosso: Dpt. Bella Vista, in cerrado vegetation near Limeira (formerly in Paraguay), calcareous region above the Río Apa, May 1912/1913. *E. Hassler 11227* (HOLOTYPE: G!, ISOTYPES: A!, BM!, G!, K!).

Malvastrum dimorphum J. T. Howell, Proc. Calif. Acad. Sci. ser. 4, 21: 331. 1935. TYPE: ECUADOR: Galápagos Islands: Indefatigable Island (Isla Santa Cruz), Academy Bay, 13 May 1932, *J. T. Howell 9294* (HOLOTYPE: CAS no. 220768; ISOTYPE: GH!).

Suffruticose perennial herb 0.6–2.0 m tall often bushy-branched; *main stem* 5–10 mm diam at base with branches up to 30–50 cm long; *stem vestiture* canescent-tomentose generally with coarse overlapping (5) 6–7 (8)-rayed stellate hairs 0.3–1.0 mm diam tardily shed in age; *cotyledons* ovate, rounded to slightly emarginate at the apex, wide-cuneate at the base, ca. 9 mm long $\times$ 9 mm wide, petiole 6–8 mm long; *stipules* (2) 3–4 (7) mm long $\times$ 0.3–0.7 mm wide, narrowly lanceolate to linear, acuminate-cuspidate, subfalcate; *petioles* (15) 25–60 (80) mm long on main leaves to 5–10 mm on apical leaves; *blades* of main stem leaves (1.0) 1.3–1.7 (2.1) $\times$ and those associated with the inflorescences 3–5 $\times$ longer than petioles, main stem leaves (40) 50–85 (115) mm long $\times$ (30) 35–75 (90) mm wide and inflorescence leaves (15) 20–45 mm $\times$ 10–20 (30) mm, average midstem blade (1.0) 1.1–1.3 $\times$ longer than wide, ovate and unlobed or very infrequently briefly 3-lobed halfway from the base, base slightly cordate in early leaves to sub-truncate broadly rounded or infrequently broadly cuneate, apex acute or less frequently

Figure 35. *Malvastrum tomentosum* subsp. *tomentosum*. a. Habit, scale = 5 cm. b. Petal, scale = 2 mm. c. Stamens, styles and stigmas, scale = 2 mm. d–f. Mericarp, lateral, distal and apical views, scale = 1 mm. g. Mericarp, internal view, scale = 1 mm. h. Fruit, apical and lateral views, scale = 2 mm. i. Seed, apical and lateral views, scale = 1 mm. j. Columella and carpocrater, scale = 0.5 mm. k. Stipule, scale = 1 mm. l. Bracteole, scale = 1 mm. m. Leaf from branch apex, scale = 2 cm. n. Leaf, midstem, scale = 2 cm. o. Stem hairs, scale = 0.5 mm. (a–c, j from *Camp E-2974*; d–f, l from *Stork, et al.* 8973; g, i from *Macbride 531*; h from *Weberbauer 7760*; k from *Rose 22548*; m from *Eggers 15778*; n from *Asplund 15688*; o from *Smyth 57*).

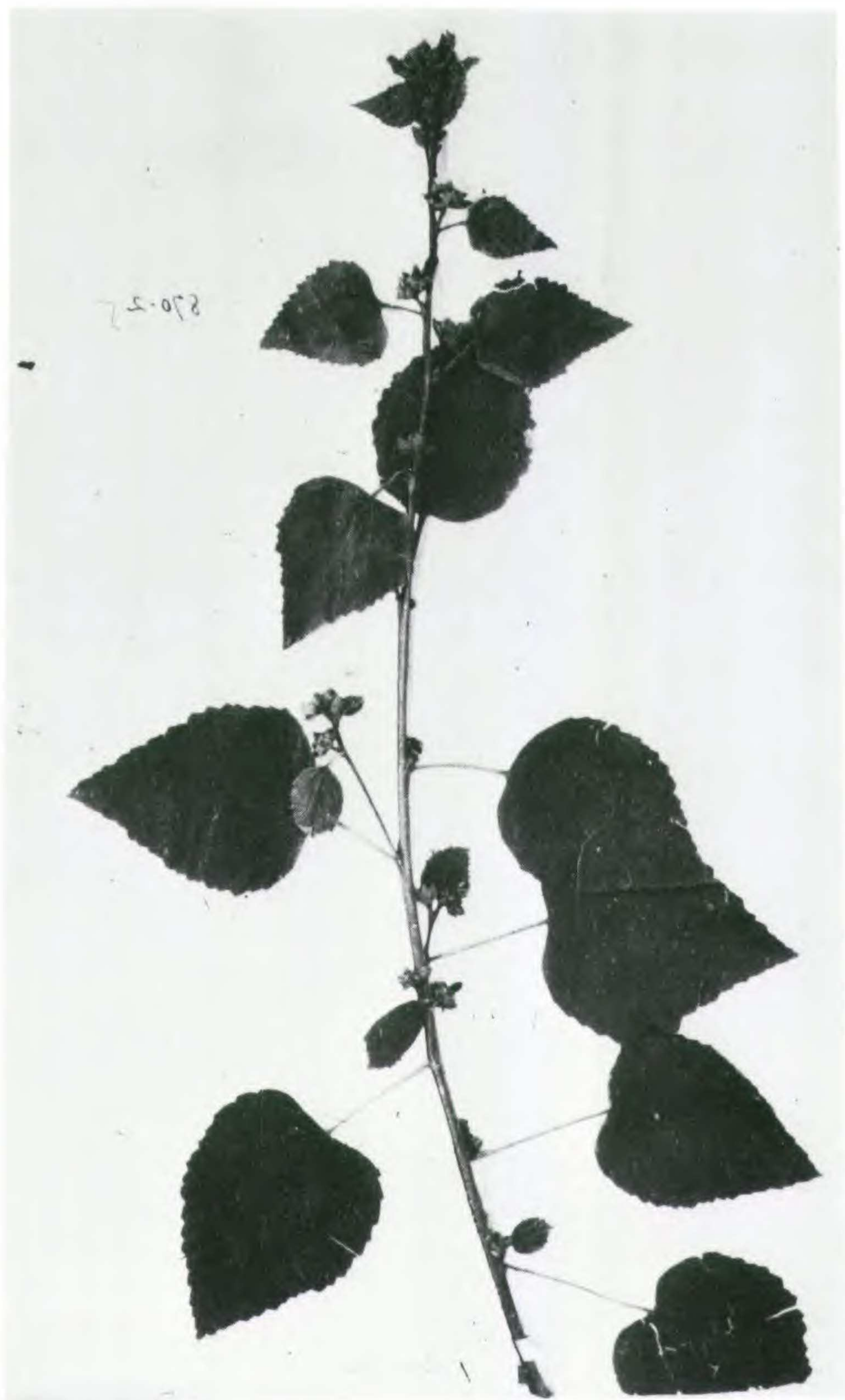


Figure 36. *Malvastrum tomentosum* subsp. *tomentosum* (lectotype).

slightly acuminate, margin crenate-dentate to dentate or nearly denticulate in upper leaves with 2.5–4 (6) teeth/cm, vesture of adaxial surface felty to slightly rough, of overlapping and often dense appressed symmetrical 6–8-rayed stellate hairs similar to those of the stem, abaxial surface pubescent-canescens and obscured by scarcely appressed 8–12-rayed stellate hairs 0.5–0.8 mm diam; *flowers* at first solitary in the axils of leaves and stipules, later congested and subtended by paired stipules and a highly reduced leaf 1–2 mm long in reduced few-flowered axillary and terminal glomerate spicate racemes, these units present on both main and secondary stems on older plants, bifid *floral bracts* lacking; *pedicels* 2.0–4.0 (15) mm long on axillary flowers and 0.5–1.0 mm long on the congested flowers, not increasing in fruit; *involucre* of 3 filiform bracteoles 3–4 (–5) mm long $\times$ 0.2–0.4 mm wide, completely free of the calyx; *calyx* united $1/3$ its length, 4–5 (6) mm long at anthesis increasing to 6–8 (11) mm in fruit, campanulate in flower and typically rotate in fruit, lobes triangular to deltate, acuminate-cuspidate or infrequently broadly cuspidate to subacute, 3–4 (5) mm long $\times$ 2–3 mm wide at anthesis to 5–6 (8) mm long $\times$ 3–4.5 (–5.0) mm wide in fruit, abaxial surface canescens with 4–8-rayed stellate or infrequently simple marginal hairs 0.1–0.5 mm diam usually obscuring the surface, adaxial surface of lobes downy-pubescent with minute arachnoid hairs on the apical half and marginally to the lobe sinus, usually strigose medially with simple or 2-rayed apically directed hairs 0.2–0.7 mm long; *corolla* (10–) 15–18 mm diam, orange-yellow to pale orange, petals asymmetrically bilobed, 6–7 (9) mm long $\times$ (3) 4–5 (7) mm wide (usually shrinking upon drying in pressed specimens), broadly campanulate and spreading at anthesis, exceeding the calyx by 2–3.5 mm, claws densely strigose-pubescent throughout to somewhat barbate with 2–4-rayed or simple hairs 0.2–0.5 mm long; *androecium* with (25) 34–38 (42) stamens, filament tube 2.5–3.0 mm long, moderately pubescent with 2–5-rayed stellate hairs 0.2–0.6 mm diam, free portion of filaments 0.9–1.4 mm long; *gynoecium* with (9) 10–12 (13) carpels, style branching 2.5–3.0 mm above the columella, each branch terminated by a single only slightly expanded sub-hemispherical stigma exerted 1.0–1.5 (2.0) mm beyond the anthers but often recurved in pressed specimens; *schizocarps* (5.5) 6.0–8.0 (9.0) mm diam including ornamentation; *mericarps* (9) 10–12 (13), appressed to slightly remote from one another at maturity, 2.0–3.0 mm in height $\times$ 2.5–4.0 mm in length $\times$

1.0–1.2 mm in width including ornamentation, with a single proximal-apical cusp (0.1) 0.2–0.5 (1.0) mm long and two conspicuous distal-apical cusps 0.8–1.8 (2.0) mm long, lateral faces somewhat smooth to conspicuously ribbed without a prolonged concave margin, raised midline present on the distal-apical surface but usually obscured apically by hairs, densely pubescent on the apical surface with tufted 8–10-rayed stellate hairs and a few simple erect hairs 0.1–0.4 mm long on the proximal cusp, the proximal-apical hairs often with 2–3 elongated ascending rays, mericarp indehiscent except for an open proximal-apical margin, lateral faces of the pericarp thin over the seed but firm to woody elsewhere, endoglossum 0.2–0.3 mm long on the apical surface 0.5 mm distal to the open proximal margin; *seeds* 1.5 mm in height $\times$ 1.8–2.0 mm in length $\times$ 0.8–1.0 mm in width, with a longitudinal cleft in the distal-apical region corresponding to the cusps on the mericarp; *chromosome number*: $n = 12$, $2n = 24$; *pollen* 46–77 (60) μm diam, *echinae* 3–6 μm , apertures 6–9 (10).

DISTRIBUTION. (Fig. 37) Moderate elevations in brushland in well-drained or dry soils surrounding the Amazon basin, most frequently in coastal regions from the Department of Ica, Peru in the south to the Province of Manabí, Ecuador in the north, with disjunct populations in the Distr. Federal and State of Aragua, Venezuela, and in the states of Ceará, Paraíba, Pernambuco, Minas Gerais, and Matto Grosso in Brazil, at elevations from near sea level to 1500 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering (in wild populations) primarily from April to late June, but also sporadically throughout the year under proper conditions. Greenhouse plants grown from seeds from *Stork et al.* 8973, *Iltis* 1591, and *da Rocha* 3 (40 years old) germinated in 1–3 weeks after planting and were in bud in early November after 6 months (180 days) growth, but did not flower well and became dormant or died in winter greenhouse conditions (as low as 2°–7° C at night). The plants were seen to grow best in warm, dry conditions. Flowering time and breeding mechanisms are unknown, but it is suspected that self-pollination mechanisms are well-developed due to the recurved styles often seen in pressed specimens and the nearly 100% fruit set.

DISCUSSION. For a detailed discussion of nomenclature in this species see Hill (1980).

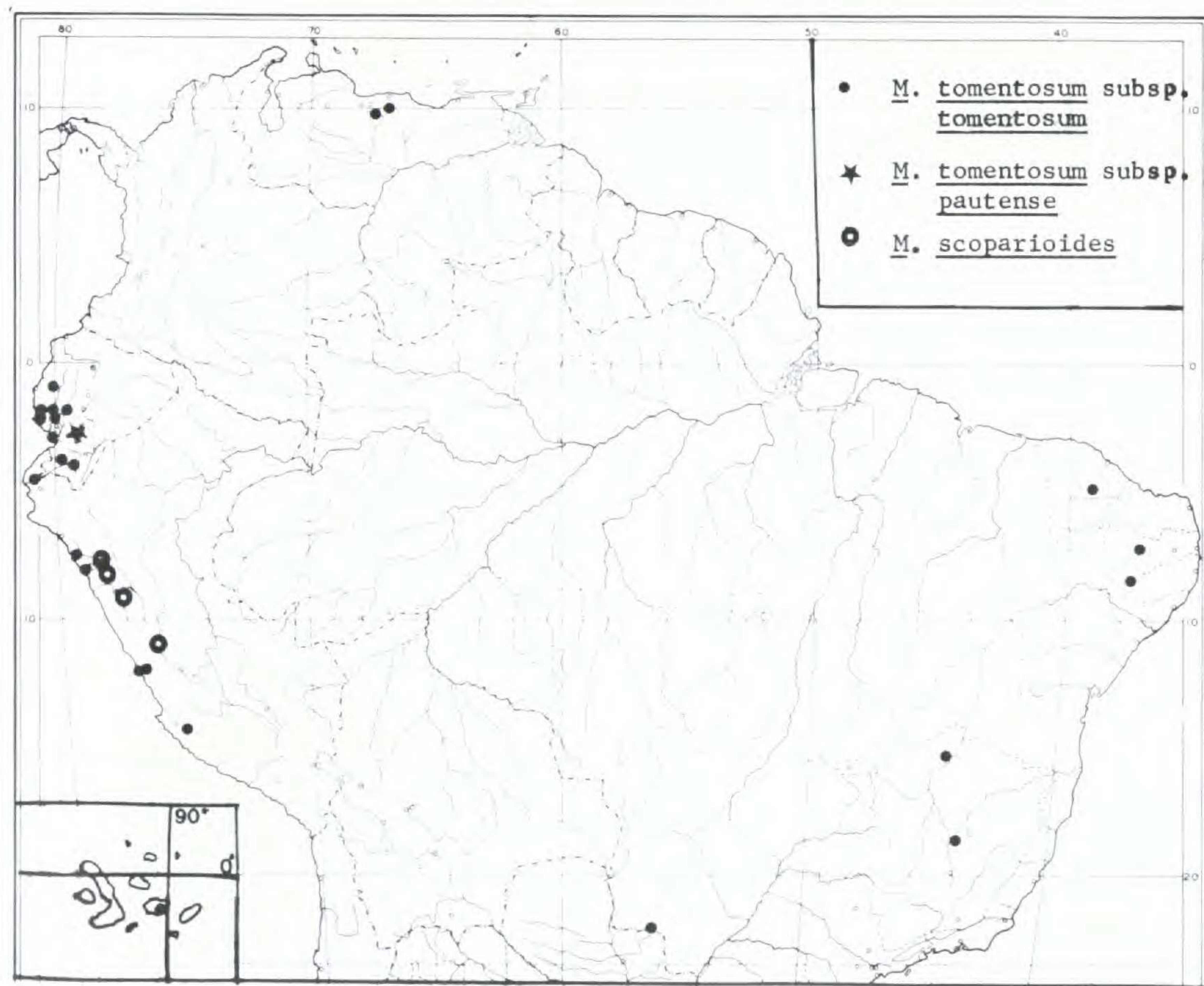


Figure 37. Distribution of *Malvastrum tomentosum* and *M. scoparioides*. Inset: Galápagos Islands.

REPRESENTATIVE SPECIMENS: **Venezuela.** ARAGUA: Colonia Tovar, *Fendler 88* (G, GH, K, NY, PH); DISTRITO FEDERAL: between Antimano and Las Adjuntas, *Pittier 12254* (G, NY, US). **Ecuador.** MANABÍ: El Recreo, *Eggers 15778* (F, K, US); GUAYAS: Guayaquil, *Hitchcock 19935* (GH, NY, US); 8 km N of Guayaquil, dry hillside, *Stork et al. 8973* (K, UC, US); ISLAND OF PUNÁ: H.M.S. Sulphur Expedition, *Sinclair s.n.* (GH, K); LOS RÍOS: Vinces, collector not indicated, (GH); CHIMBORAZO: Huigra, Hacienda de Licay, *Rose et al. 23886* (GH, NY, US); cañon of the río Chanchan near Huigra, *Camp E-2974* (CAS, F, GH, K, MO, NY, US); EL ORO: Santa Rosa, *Asplund 15688* (B, NY); LOJA: Catamayo Valley near La Toma (Catamayo) *Wiggins 10955* (CAS, DS, MO); GALÁPAGOS ISLANDS: Indefatigable Island (Santa Cruz), Academy Bay, Pelican Bay, *Schimpff 35* (BKL, CAS, G, GH, MO, NY, U); Academy Bay, *Howell 9294* (CAS, GH). **Peru** PIURA: Prov. Paíta, La Brea, *Weberbauer 7760* (F); CAJAMARCA: Prov. Cutervo, Izco, *Stork & Horton 10208* (F, UC); LA LIBERTAD: Chicama Valley, cultivated fields, *Smyth 57* (US); LAMBAYEQUE: mouth of the río Chancay, *Spruce 6390* (BM, G, K, OXF); LIMA: Chosica, in river gravel, *Macbride & Featherstone 531* (F, G, GH); ICA: Prov. of Nazca, Nazca, *Iltis et al. 1591* (BH, WIS). **Brazil.** BAHÍA: Brejões, Estrada BR. 4, *Krapovickas 12785* (MICH, UC); CEARÁ: *da Rocha 3* (US); PARAIBA: fields in Areia, *Moraes 810* (NY, U); PERNAMBUCO: Tapera, *Pickel 3751* (GH, NY); MINAS GERAIS: 1 km E of río Pandeiros, road to Januária, *Anderson et al. 9099* (NY, pf, UB); MATTO GROSSO: Dpto. Bella Vista, near Limeira, above the río Apa, *Hassler 11227* (A, G).

- 6b. ***Malvastrum tomentosum*** (Linnaeus) S. R. Hill subsp. ***pautense*** S. R. Hill, *Brittonia* **32**(4): 470. 1980 TYPE: ECUADOR, Azuay: dry hillsides along roadside in valley of Río Paute, alt. ca. 7700 ft, 24 Sept. 1944, *I. L. Wiggins 10788* (HOLOTYPE: GH!; ISOTYPES: CAS!, DS!, NY!, TEX!, US!). Fig. 38, 39.

Similar to the typical subspecies in most respects, but differing in its campanulate calyces with incurved and not patent lobes in fruit, in the shorter distal cusps which are 0.5–0.7 mm long, in the larger stellate hairs on the apical surface that are 0.5–0.7 mm long and generally have several elongate, centrally directed rays, in the very inconspicuous endoglossum, and in the absence of the sulcus that is present on the seeds of the typical subspecies. The leaves seem to be more frequently trilobed than in subsp. *tomentosum*; *chromosome number*: not known; pollen: 77–90 (84) μm diam, echinae 4–5 μm , apertures 7–10.

DISTRIBUTION. (Fig. 37) Restricted to the region of the río Paute, Province of Azuay, Ecuador, on dry cliffs and rocky hillsides at elevations of 2400–2700 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering in September and again in March and April. A plant grown from seed from the



Figure 38. *Malvastrum tomentosum* subsp. *pautense*. a. Habit, scale = 5 cm. b-d. Mericarp, lateral, distal and apical views, scale = 1 mm. e. Mericarp, internal view, scale = 1 mm. f. Fruit, apical and lateral views, excluding vestiture, scale = 2 mm. g. Seed, scale = 1 mm. h. Columella and carpocrater, scale = 0.5 mm. i. Stipule, abaxial surface, scale = 1 mm. j. Bracteole, abaxial surface, scale = 1 mm. k. Leaf variation, apical leaves, scale = 1 cm. l. Stem hairs, scale = 0.5 mm. (a,f,h-l from *Camp E-2542*; b-e and g from *Wiggins 10788*).

type (*Wiggins 10788*, 34 years old) grew poorly in the warm greenhouse temperatures in Texas, germinating 35 days after planting, and produced two flowers in September (after ca. 100 days of growth) that self-pollinated to produce two fruits. In the winter months the plant became dormant but remained green while plants of the typical subspecies died from the nearly freezing temperatures.

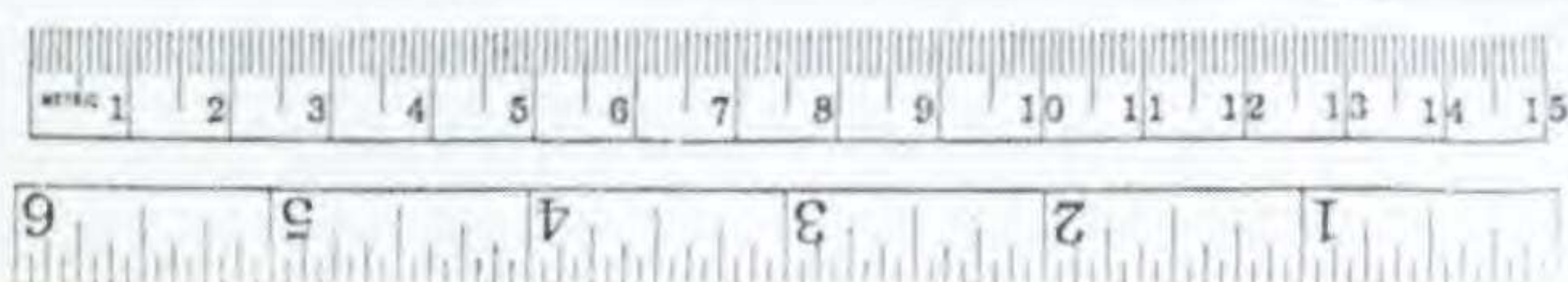
DISCUSSION. During the examination of specimens of *M. tomentosum* a small set of unusual forms was set aside. Upon re-examination, it was seen that these "atypical" specimens not only had a morphic continuity with one another but also originated in a single province (Azuay) in Ecuador at elevations greatly exceeding those of the species overall. These considerations led me to treat this population as a new subspecies of *M. tomentosum*. It is interesting that this population that is so near to the frequency center of the species is much more divergent in its characters than are the isolated populations of the species in Venezuela and Brazil.

It is my view that the two subspecies are effectively isolated from one another. Since isolation in the río Paute basin, selective pressures to maintain the mericarp cusps for transport have probably lessened. The plants seem also to have adapted physiologically to the cooler temperatures of the higher elevations.

SPECIMENS EXAMINED: **Ecuador.** AZUAY: Dry hillsides, valley of the río Paute, *Wiggins 10788* (CAS, DS, GH, NY, TEX, US); between ríos Azogues and Gualaceo, valley of the río Paute between Paute and Cuenca, Camp *E-2339* (CAS, G, NY) and *E-2542* (CAS, NY, UC).

7. ***Malvastrum scoparioides*** E. Ulbrich, Notizbl. Königl. Bot. Gart. Berlin 11: 525. 1932. TYPE: PERU: Ancash: Prov. Huailas, beyond Pamparomas, between Samanco and Caras, woodland near brook, altitude 2000–2200 meters, May 29, 1903. *A. Weberbauer 3196* (HOLOTYPE: B — (lost) fragment at CAS!; ISOTYPE: MOL). Fig. 40, 41.

Malvastrum scabrum sensu A. Gray, Bot. U. S. Expl. Exped. 1: 147. 1854, excl. basionym. Applied to a specimen collected on the Wilkes Expedition (US!) which is this species and which Gray considered to be the *Malva scabra* of Cavanilles.



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10,768 Plants of Ecuador

Malvastrum scoparium (L'Her.) A. Gray?
(Det. T. S. Kearney 1952)

Shrub to about 2 m. Branches straggly.
Flowers pale orange.
Dry hillsides along roadside in valley
of Rio Tupe, alt. about 7,700 ft.

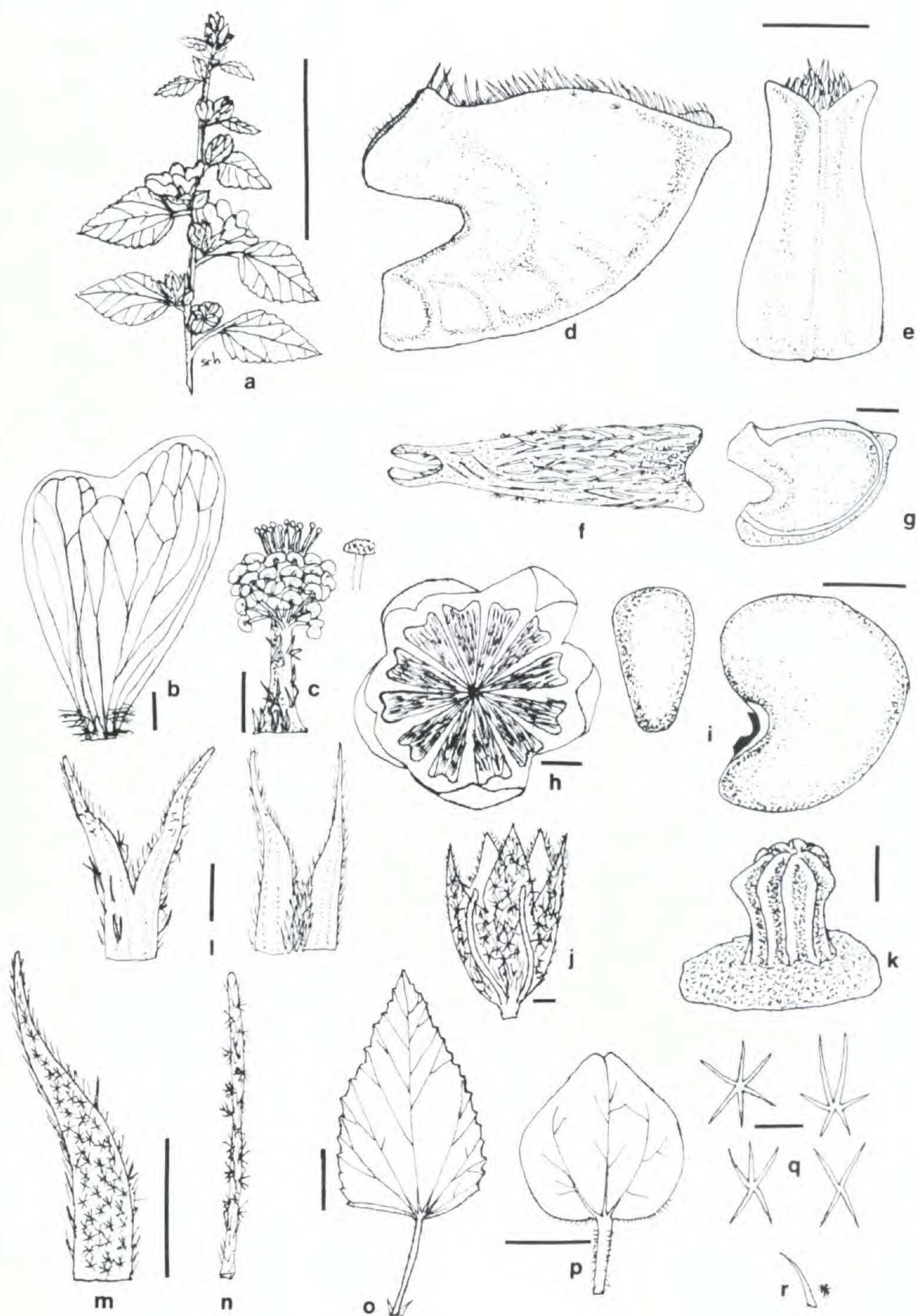
Azuay Province

Ira L. Wiggins

Sept. 24, 1944

Suffruticose to subarborescent perennial herb 1–3 m tall, sparsely branched the first year, later bushy-branched; *main stem* 10 (15) mm diam at base; *branches* to 30–45 cm long; *vesture* of scattered appressed (4) 5–6 (7)-rayed stellate hairs 0.3–0.9 mm diam persistent or tardily shed; *cotyledons* wide-ovate, apex briefly emarginate, base truncate to broadly cuneate, 10–11 mm long $\times$ 11 mm wide; *stipules* 3–4 (5) mm long $\times$ 0.7–0.9 mm wide, narrowly lanceolate to linear, acuminate-cuspidate, subfalcate; *petioles* 35–70 (100) mm long to 5–15 mm in inflorescence leaves; *blades* of lower leaves 1.5–3.0 $\times$ and those associated with the inflorescence 4–6.5 $\times$ longer than petioles, lower blades 65–90 (125) mm long $\times$ 50–85 (90) mm wide, those with the inflorescence (25) 30–40 (60) mm long $\times$ 20–25 mm wide, average midstem blade 1.3–1.6 $\times$ longer than wide, ovate, usually unlobed but infrequently briefly 3-lobed halfway from the base, base cordate to rounded or wide-cuneate, apex acute to acuminate, gradually tapering from the middle, margin coarsely dentate to denticulate with 1–2 to 5 teeth/cm, vesture of the adaxial surface of scattered (5) 6 (7)-rayed hairs 0.2–0.9 mm diam or simple towards the margins, occasionally with 2 or 3 elongated marginally directed rays, abaxial surface more densely pubescent with fine scarcely appressed (6) 8–10-rayed stellate hairs 0.5–0.8 mm diam; *flowers* solitary in the axils of reduced leaves and stipules at first, later in congested reduced terminal and axillary few-flowered racemes and subtended by paired stipules and minute leaf or a bifid *floral bract* 5.5–6.0 mm long $\times$ 1.0–1.2 mm wide divided 2/3 to 5/6 its length; *pedicels* 0.7–1.0 (4.0) mm at anthesis increasing by less than 1 mm in fruit; *involucl* of 3 filiform bracteoles 4–5 mm long $\times$ 0.3–0.5 mm wide completely free of the calyx; *calyx* united 1/3 to 3/5 its length, 8–9 mm long at anthesis to 10–11 mm in fruit,

Figure 40. *Malvastrum scoparioides*. a. Habit, scale = 5 cm. b. Petal, scale = 2 mm. c. Stamens, styles, and stigmas, stigma enlarged, scale = 2 mm. d.–f. Mericarp, lateral, distal, and apical views, scale = 1 mm. g. Mericarp, internal view, scale = 1 mm. h. Fruit, apical view, without vesture, scale = 2 mm. i. Seed, scale = 1 mm. j. Calyx at anthesis, scale = 2 mm. k. Columella and carpocrater, scale = 0.5 mm. l. Floral bracts, fully developed and transitional forms, scale = 2 mm. m. Stipule, scale = 2 mm. n. Bracteole, scale = 2 mm. o. Midstem leaf, scale = 2 cm. p. Cotyledon, scale = 5 mm. q. Stem and leaf hairs, scale = 0.5 mm. r. Mericarp hairs, scale = 0.5 mm. (all from living and cultivated specimens of López-M & Sagástequi-A. 8020).



campanulate, lobes slightly spreading at anthesis and erect to incurved in fruit, triangular, acuminate-cuspidate, 5 mm long $\times$ 3–4 mm wide to 7 mm long $\times$ 4–5 mm wide in fruit, abaxial surface canescent with minute simple to 6-rayed stellate hairs 0.05–0.2 mm diam and similar larger stellate hairs 0.5–0.7 mm in diam, adaxial surface of lobes conspicuously downy pubescent with minute simple or 2-rayed arachnoid hairs on the apical 1/2 and marginally to the lobe sinus; *corolla* pale orange, 23–24 mm diam when spread, petals asymmetrically bilobed, 10–11 (13) mm long $\times$ 9–10 mm wide, broadly campanulate or spreading and exceeding the calyx by 4–5 (6) mm, claws densely barbate-pubescent with fine simple or 2–4-rayed stellate hairs 0.8–1.0 mm long; *androecium* with 36–46 stamens, filament tube 4.0 mm long, sparsely pubescent with 2–5-rayed stellate hairs 0.8–1.0 mm diam, free portion of filaments 1.0–1.5 mm long; *gynoecium* with (10) 11–12 carpels, style branching 3.5–4.0 mm above the columella, each branch terminated by an expanded somewhat flattened subhemispherical to discoid stigma exerted 2 mm beyond the anthers, not recurved at flower wilt; *schizocarps* 8–9 mm diam including ornamentation; *mericarps* (10) 11–12, divergent at maturity, 2.5–3.0 mm in height $\times$ 3.5–4.0 mm in length including ornamentation $\times$ 1.2–1.6 mm in width, with a minute apical cusp 0.05–0.2 mm long and two apical-distal cusps 0.3–0.6 mm long, lateral faces smooth or inconspicuously ribbed at the distal and basal margins which are narrowly prolonged to form a concave rim, distal and basal surfaces with a conspicuous raised medial line, vestiture restricted to the apical surface and the extreme apical margin of the lateral surfaces consisting of appressed proximally-directed simple hairs 0.5–0.8 mm long mixed with minute stellate hairs ca. 0.1 mm diam, mericarp proximal-apical margin usually unsealed at maturity, lateral portion of pericarp over the seed thin and chartaceous the remainder somewhat woody, minute endoglossum present on the apical surface 1.0 mm distal to proximal margin, tardily separating from the receptacle; *seeds* 2.0 mm in height $\times$ 2.2 mm in length $\times$ 1.0 mm in width; *chromosome number*: $2n = \text{ca. } 48$; *pollen* 67–93 (76) μm diam, echinae 5 μm , apertures 10–18.

Figure 41. *Malvastrum scoparioides* (holotype photo, and fragment, CAS).



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Typus!

Ex Museo botanico Berolinensi.

Nº 3196 Dr. h. C. Deberbauer, Flora von Peru

Malvastrum scoparioides Kuhn, sp. n.

in Notizbl. d. Bot. Gart. u. Museum Wien, Berlin
Nr. 107, 15. Jg. 1932, p. 525.

Typus!

Peru: Dept. Arequipa, Unter den Pampas, 10000
ft. (10000 ft. = 3048 m), 10000 ft. in
Anden, 10000 ft. = 3048 m, 10000 ft. = 3048 m.
29. Juni 1932. Dr. h. C. Deberbauer

Druck: J. B. Neumann, Neudamm 1932.



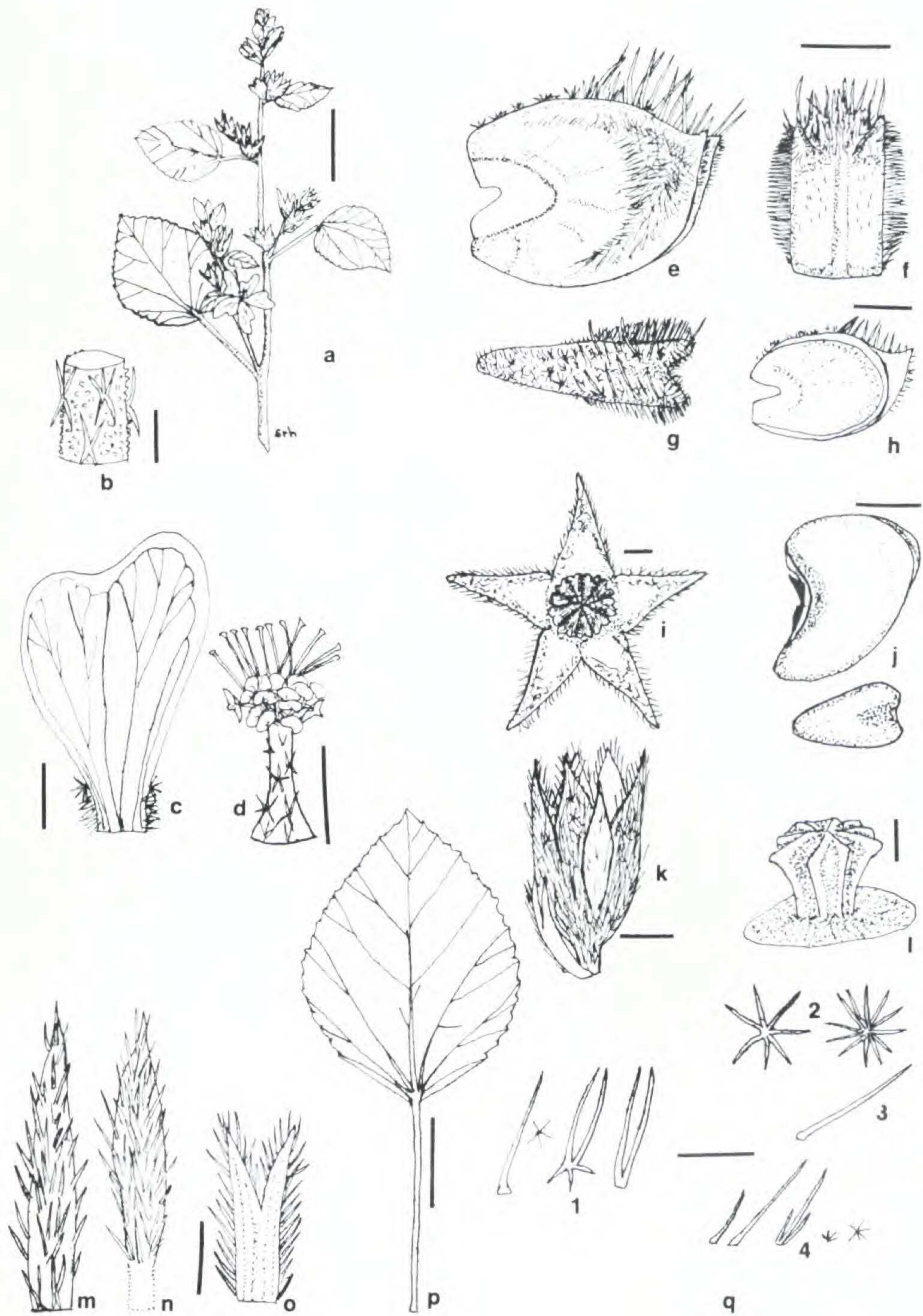
DISTRIBUTION. (Fig. 37) Restricted to hillsides and slopes in the Departments of southern Cajamarca, La Libertad, Ancash and northern Lima, Peru, at moderately high elevations of 1300–2200 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering in April and May, but has also been collected in flower and fruit in early September. Greenhouse plants grown from seeds from *López-M. & Sagástegui-A. 8020* (five years old) germinated in two weeks after planting and flowered for the first time in January after eight months growth. The plants grew slowly in the summer months in elevated temperatures (29°–39° C) but well in the cooler weather in the greenhouse while the *Malvastrum tomentosum* plants were becoming dormant or moribund. The flowers opened at 11 am CST and closed at 4:30–5 pm CST. The stigmas remained exerted throughout and did not recurve preventing pollination. Self-pollination failed to produce fruit.

DISCUSSION. *Malvastrum scoparioides* has been confused with *Malva scabra* Cavanilles (*Malvastrum scabrum* (Cav.) A. Gray) which has similar leaves. However, the larger flowers, presence of bifid bracts, the reduced cusps, the vestiture of simple hairs on the mericarp, and the divergence of the mericarps in fruit separate *M. scoparioides* from *M. tomentosum*. A tentative root tip chromosome count suggests that this is a polyploid species, possibly an octoploid. If so, this would be the second octoploid known in the genus. The occurrence of the species at high altitudes is correlated with the higher ploidal level.

In cultivation, individuals of this species were better able to withstand nearly freezing winter temperatures and were more resistant to insect and fungal predation than were individuals of *Malvastrum tomentosum*. Warm summer temperatures discouraged

Figure 42. *Malvastrum guatemalense*. a. Habit, scale = 5 cm. b. Stem vestiture, scale = 0.5 mm. c. Petal, scale = 2 mm. d. Stamens, styles, and stigmas, scale = 2 mm. e.–g. Mericarp, lateral, distal, and apical views, scale = 1 mm. h. Mericarp, internal view, scale = 1 mm. i. Fruit, apical view, scale = 2 mm. j. Seed, lateral and apical views, scale = 1 mm. k. Calyx and bract at anthesis, scale = 2 mm. l. Columella and carpocrater, scale = 0.5 mm. m. Stipule, scale = 1 mm. n. Bracteole, scale = 1 mm. o. Floral bract, scale = 1 mm. p. Leaf, scale = 2 cm. q. Vestiture variation: 1) calyx, 2) leaf, abaxial surface, 3) leaf, adaxial surface, 4) mericarp, scale = 0.5 mm. (a,d,i,l from *Standley 77661*; b, from *Williams & Molina 10865*, c,k,m–n, p–q from *Standley 78534*, e–h,j,o from *Williams, et al. 23821*).



flowering. *Malvastrum scoparioides* is interpreted to be a polyploid derivative of *M. tomentosum*, physiologically, cytologically, and ecologically isolated from contemporary populations of that species. Convergence in characters resulting in a coincidental similarity with *M. tomentosum* subsp. *pautense* seems to have taken place as a result of an adaptation to a very similar habitat.

SPECIMENS EXAMINED. **Peru.** CAJAMARCA: Prov. Contumazá, Cascas - Contumazá, hillside, López-M. & Sagástegui-A. 7672 (MO, pf, US); LA LIBERTAD: Prov. Otuzco, Hda. Membrillar, López-M. 596 (US); Prov. Otuzco, road from Simbel to La Cuesta, López-M. & Sagástegui-A. 8020 (F, GH, MO, NY); ANCASH: Prov. of Huailas, beyond Pampa-romas, between Samanco and Caras, Weberbauer 3196 (CAS); LIMA: Prov. of Canta, Obrajillo, Wilkes Expedition s.n. (US).

8. ***Malvastrum guatemalense*** Standley & Steyermark, Publ. Field Mus. Nat. Hist., Bot. Ser. 23: 174. 1944. TYPE: GUATEMALA. Santa Rosa, near Cuilapa, in wet thicket, alt. 900 meters, November 20-27, 1940. P. C. Standley 78534 (HOLOTYPE; F!). Fig. 42, 43.

Suffruticose, perennial herb to 2 m tall, apparently sparsely branched; *mid-stem* diam 5 mm; *branches* to 50 cm long, vesture sparse, consisting of minute simple hairs 0.1-0.2 mm long perpendicular to the stem and appressed (2) 4-5 (6)-rayed stellate hairs (0.2) 1-1.5 (2.0) mm diam; *cotyledons* not known; *stipules* 4-5 mm long $\times$ 0.6-0.8 mm wide, narrowly lanceolate to linear; *petioles* (20) 40-50 mm long; *blades* 1.4-2 $\times$ longer than the petioles (30) 60-75 (90) mm long $\times$ (25) 35-55 (60) mm wide, average midstem blade 1.3-1.5 $\times$ longer than broad, ovate wide-ovate to elliptic, unlobed or minutely 3-lobed 2/3 the distance from the rounded to broadly cuneate base, apex acute, margin crenate-dentate with 3-4 teeth/cm, vesture of the adaxial surface consisting of scattered evenly arranged apically directed simple hairs 1.5 mm long, abaxial pubescence of 6-12-rayed stellate hairs 0.4-1.0 mm diam; *flowers* typically in loosely flowered terminal racemes and in reduced axillary racemes in the axils of upper leaves and stipules or subtended by *floral bracts* 3-4 mm long $\times$ 0.8-1.0 mm wide; *pedicels* 1-2 (4) mm long, increasing about 1 mm in fruit; *involucl* of 3 lanceolate bracteoles 5-7 mm long $\times$ 0.6-0.8 mm wide, united to the calyx 1.5-2.0 mm at base; *calyx* united 1/4 to 1/3 its length, somewhat campanulate, 6-8 mm long to 8-11 mm in fruit, lobes only slightly spreading in flower and

Figure 43. *Malvastrum guatemalense* (holotype).

fruit, narrowly triangular, acuminate, 5–7 (9) mm long $\times$ 2–4 mm wide, strigose on the outside with coarse simple hairs 1–1.5 mm long occasional 2–5-rayed hairs and appressed minute stellate hairs 0.1–0.3 mm diam covering the remaining surface, internal surface of lobes downy pubescent with minute arachnoid hairs on the upper two-thirds; *corolla* pale yellow or yellow orange, petals asymmetrically bilobed, 7–9 mm long $\times$ 6 mm wide, spreading at anthesis, exceeding the calyx by 2–3 mm, claw pubescent at base with rather dense stellate and simple hairs; *androecium* with 38–44 stamens, filament tube 2–2.5 mm long, pubescent with fine 2–6-rayed stellate hairs resembling those of the claws, free portion of filaments 1.0 mm long; *gynoecium* with 9–10 carpels, style branching 2 mm above the base into 9–10 branches, each with a single terminal hemispherical expanded stigma exceeding the anthers by 1–1.5 mm; *schizocarps* 4.5–6.0 mm diam; *mericarps* 9–10 (usually 10), 2 mm in height $\times$ 3 mm in length (including ornamentation) $\times$ 1.0 mm in width excluding hairs, with two distinctly separate distal-apical cusps 0.5 mm long, lateral faces unribbed, vestiture of the apical surface of small stellate hairs 0.1–0.4 mm diam mixed with large rigid simple hairs 1.0 mm long with intermediates, lateral margins with a distinctive dense vestiture of small simple bristle-like hairs 0.3 mm long perpendicular to the faces forming a thick brush, pericarp indehiscent, endoglossum lacking, apparently readily separating from the receptacle at maturity; *seeds* 1.5 mm in height $\times$ 2 mm in length $\times$ 1 mm in width with a noticeable sulcus on the apical-distal surface; *chromosome number*: not known; *pollen*: 71.7–79.4 (74.7) μ m diam, echinae 2.5–5 μ m, apertures 6–7.

DISTRIBUTION. (Fig. 44) Known from forested regions of Guatemala, Honduras, and Nicaragua at elevations of 600–1200 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering in late October–January. The exerted stigmas suggest that effective cross-pollination is possible. Daily flowering time not known.

DISCUSSION. There remains some question whether *M. guatemalense* should be considered a distinct species or another subspecies of *M. bicuspidatum*. I have retained it in the rank of species on the basis of its disjunct range (the subspecies under consideration have contiguous ranges), as well as on the basis of

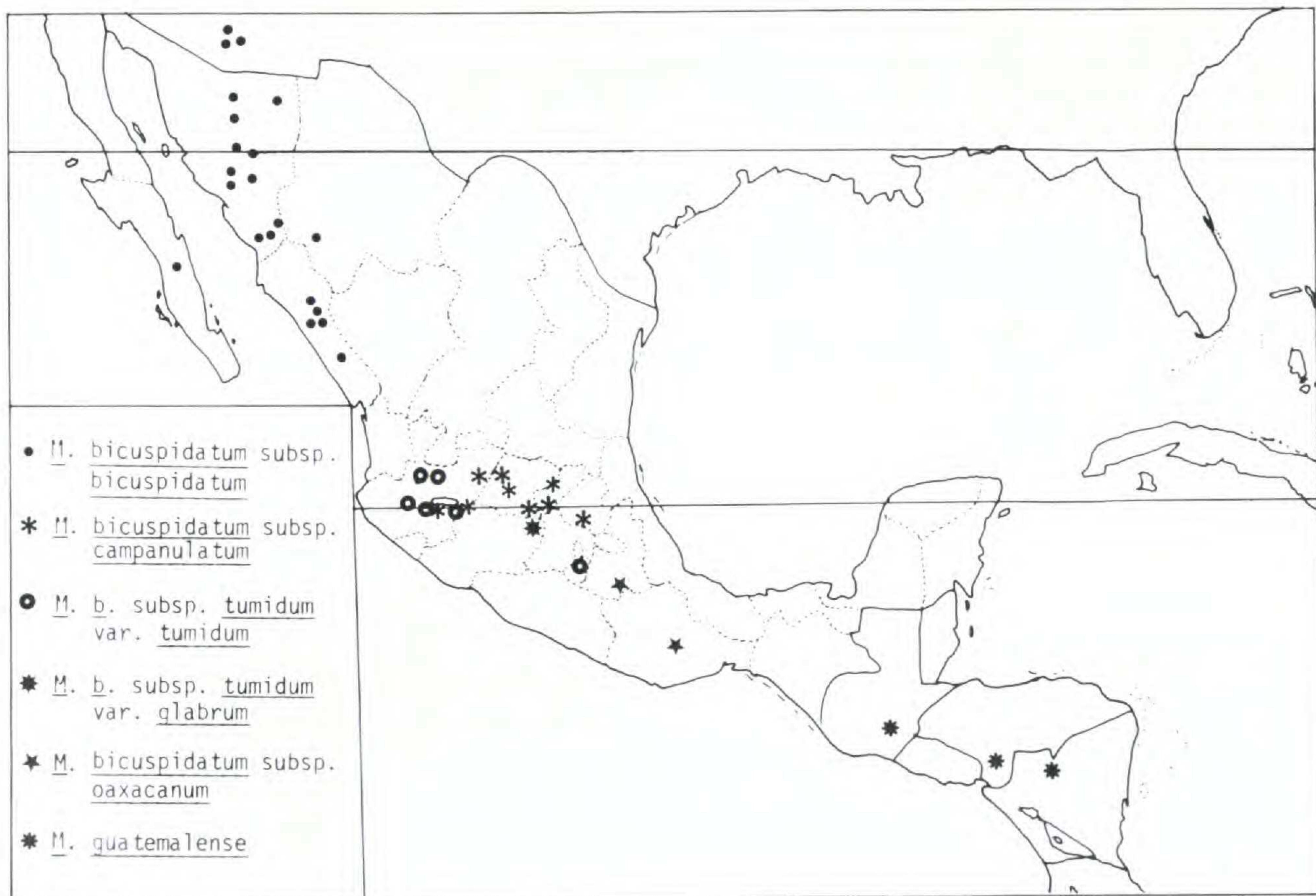


Figure 44. Distribution of *Malvastrum* section *Tomentosum* in North America.

several morphic features that do not occur in *M. bicuspidatum* (e.g. the unusual vestiture characters of the mericarps and stems). Numerical data presented in Appendix II suggest that *M. guatemalense* is more closely allied with *M. bicuspidatum* subsp. *tumidum* than that taxon is with the other subspecies of *M. bicuspidatum*. Surely the two are very close, but most of the similarities are those of a reductional or derived nature, or pertain to ecologically adaptive vegetative features; the mericarps are very different. *Malvastrum guatemalense* is not only geographically isolated from *M. bicuspidatum*, but its occurrence in mesic, forested regions rather than in semi-arid areas suggests that it is also ecologically (or physiologically) isolated from the latter species.

SPECIMENS EXAMINED. **Guatemala.** SANTA ROSA: near Cuilapa, *Standley* 77661 (F); near Cuilapa, *Standley* 78534 (F); **Honduras.** CHOLUTECA: Bella Vista, *Williams & Molina* 10865 (F); **Nicaragua.** MATAGALPA: 5–10 km W of Matagalpa, *Williams et al.* 23821 (G, NY, TEX, US).

9a. ***Malvastrum bicuspidatum*** (S. Watson) Rose subsp. ***bicuspidatum***, Contr. U. S. Natl. Herb. 12: 286. 1909. Fig. 45, 46.

Malvastrum tricuspidatum (R. Br. in Aiton) A. Gray var. *bicuspidatum* S. Watson, Proc. Amer. Acad. Arts 21: 417. 1886. TYPE: MEXICO. Chihuahua, Hacienda San Miguel, 1 mile from Batopilas along the Batopilas River, alt. 2400 feet, August, 1885. *E. Palmer* 8 (HOLOTYPE: GH! ISOTYPES: BM!, K!, MICH!, NY!, PH!, US!).

Sphaeralcea scoparia sensu Tidestrom, Proc. Biol. Soc. Wash. 48: 41. 1935, excl. basionym. Applied to specimens of *M. bicuspidatum* from Arizona.

Suffruticose perennial herb to 1.5 m tall but occasionally dwarfed to 0.4 m, typically rather sparsely branched (bushy-branched in the Tucson Mountains); *stems* 4–8 mm diam at base; *branches* 25–50 cm long; *vestiture* of appressed (4) 5-rayed stellate hairs 1 mm diam directed longitudinally on the stem and minute 4–8-rayed stellate hairs 0.3 mm diam, shed in age; *cotyledons* ovate to broadly elliptic, rounded at the apex, widely cuneate at the base, 9.0–9.5 mm long $\times$ 8.5 mm wide, petiole 7–8 mm long; *stipules* (3) 5–6 (8) mm long $\times$ 1 mm wide, somewhat falcate, narrowly lanceolate; *petioles* (6) 10–25 (70) mm long; *blades* (1.8) 2.5–3.5 (4) $\times$ longer than the petioles, (13) 30–50 (100) mm long $\times$ (11) 15–30 (90) mm wide, average midstem blade 1.3–1.7 $\times$ longer than wide, earliest vegetative blades wide-ovate to obscurely 3-lobed often as wide as long and broader than

those produced later on upper portions of the stem, mid- and upper stem blades narrowly ovate to nearly lanceolate, unlobed, base of youngest blades obscurely cordate to truncate and rounded to wide-cuneate in upper leaves, apex acute to acuminate, margin dentate to sharply dentate with 3–5 teeth/cm, vesture of the adaxial surface a mixture of fine-textured predominately 4-rayed stellate hairs and simple to 5–8-rayed hairs 1.0 mm diam, abaxial vesture similar but simple hairs scarce or absent; *flowers* typically solitary in the axils of upper leaves and stipules at first, later borne in elongated racemes at branch apices in axils of bifid bracts, occasionally produced in highly reduced few-flowered racemes in upper leaf axils associated with primary inflorescence; *floral bracts* divided $1/4$ to $1/2$ their length; *pedicels* normally 0.5–1.5 (5) mm long appearing longer in flowers produced on leafless single-flowered articulated axillary branches at the base of the inflorescence, increasing by 0.5–1.0 mm in fruit; *involucl* of 3 narrowly lanceolate to lanceolate somewhat falcate bracteoles 4–6 mm long $\times$ 0.5–1 mm wide, spirally inserted on the calyx at different levels, united to the calyx 1–2 mm below; *calyx* united $1/4$ to $1/2$ its length, 6–8 mm from pedicel to apex of lobes to 7–9 mm in fruit, rotate, lobes patent, deltate to triangular, acute to acuminate-cuspidate, in fruit 5–7 mm long $\times$ 3–4 mm wide, vesture of sparse stellate 2–6-rayed hairs and a few simple marginal hairs 0.8–1.5 mm diam but the lobes not especially ciliate, and with frequent minute stellate 5–8-rayed hairs 0.2–0.4 mm diam, base of calyx with surface obscured, lobes downy-pubescent in upper $2/3$ within with minute arachnoid simple hairs; *corolla* orange to orange-yellow, petals slightly asymmetric but lobes subequal, petals 6–8 mm long $\times$ 7 mm wide, rotate, exceeding the calyx 3–4 mm, claw pubescent at base with dense stellate hairs; *androecium* with (30) 36–45 (58) stamens tending towards 40, filament tube 2–3 mm long pubescent with sparse spreading 2–5-radiate stellate hairs, free portion of filaments 0.9–1.0 mm long; *gynoecium* with 9–12 carpels, style branching 2 mm above the columella, each branch terminated by an expanded hemispherical to subglobose stigma exceeding the stamens by 1–1.5 mm recurved at flower wilt; *schizocarps* (5.5) 6–7 (8) mm diam including ornamentation *mericarps* 9–12, 1.8–2.0 mm in height $\times$ 3–4 mm in length $\times$ 1 mm in width including ornamentation, often tinted pale rose before drying tan, lacking a proximal cusp or with a small mucro less than 0.1 mm long, with



two conspicuous divergent distal-apical cusps (0.5) 1.0–1.5 mm long, lateral faces conspicuously ribbed, distal and apical surfaces with an inconspicuous raised medial line obscured by hairs, vesture of the distal and apical surface and cusps consisting of rigid simple hairs 0.1–1.0 mm long mixed with smaller simple stellate and intermediate hairs, the lateral faces essentially glabrous except on the extreme margins and near the cusps, pericarp firm and woody, completely indehiscent, endoglossum lacking; *seeds* 1.5 mm in height $\times$ 2 mm in length $\times$ 0.8 mm wide, furrowed on the distal-apical surface; *chromosome number*: $n = 12$, $2n = 24$; *pollen* 51–67 (60) μm , *echinae* 3.8–4.0 μm , *apertures* 5 to 7, usually 7.

DISTRIBUTION. (Fig. 44). Known from slopes in arid and semi-arid regions of low to moderate elevation, 30–1300 m, primarily in the Sonoran Desert: from the Tucson Mountains of Arizona in the north, to southern Sinaloa in the south, to northeastern Sonora and extreme southwestern Chihuahua in the east, and west nearly to the coast with an outlying station in south-central Baja California.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering in late August to mid-October in the north and into late November towards the south, sparingly into January and February. In the Arizona population flowering occurs again in late March to early May on new growth after winter rains, but ceases again until late summer rains fall. This pattern was repeated in plants grown from seeds (as much as 24 years old) in Texas at nearly the same latitude. The first flowers were produced after 120 days growth, and were

Figure 45. *Malvastrum bicuspidatum* subsp. *bicuspidatum*. a. Habit, scale = 5 cm. b. Flower-bud and bract, scale = 2 mm. c. Petal, scale = 2 mm. d. Stamens, styles, and stigmas, scale = 2 mm. e. Floral bract, scale = 2 mm. f.–h. Mericarp, lateral, distal, and apical views, scale = 1 mm. i. Mericarp, internal view, scale = 1 mm. j. Fruit, apical view, scale = 2 mm. k. Seed, scale = 1 mm. l. Fruiting calyx, lateral-basal view, scale = 2 mm. m. Columella and carpocrater, scale = 0.5 mm. n. Stipule, scale = 2 mm. o. Bracteole, adnate portion stippled, scale = 2 mm. p. Leaf, from inflorescence base, scale = 2 cm. q. Leaf, early vegetative growth, scale = 2 cm. r. Cotyledon, scale = 5 mm. s. Stem vesture, scale = 0.5 mm. t. Vesture, adaxial leaf surface, scale = 0.5 mm. u. Vesture, mericarp, scale = 0.5 mm. (a,e,k–m, o from progeny of Bye 6940; b from Shreve 6111; c–d,p,s–u from Palmer 8; f–j, n from Palmer 790; q from Fryxell 3082; r from progeny of Lehto, et al. 19487).



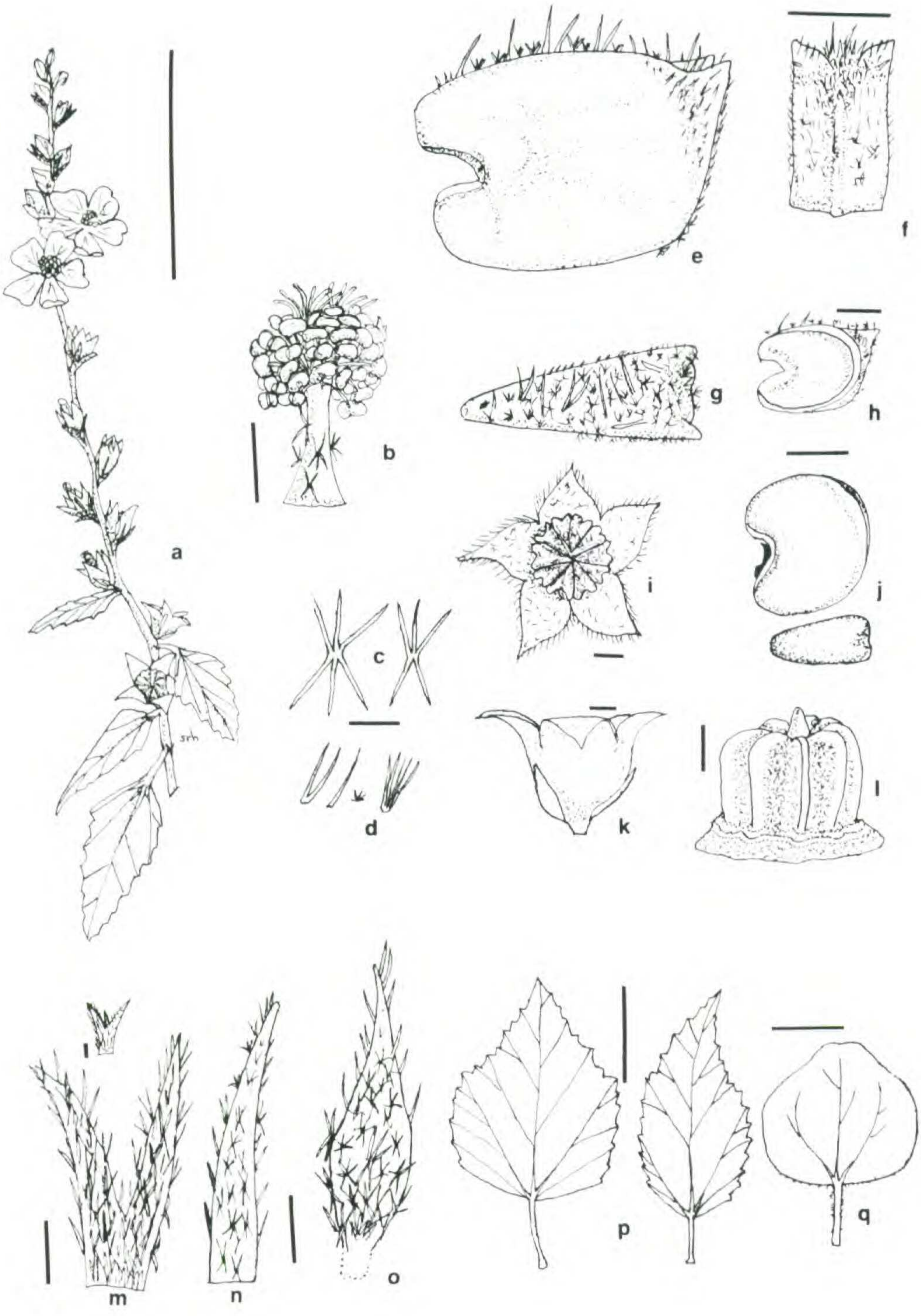
then produced continually for five months. The plants were dormant during the winter. The flowers generally opened in the mid or late afternoon (2:30 CST) and remained open until after sunset (until 7:30 CST) occasionally remaining open all night and closing the next day. The stigmas are at first well-exserted from the stamen column but, as the flower wilts, they bend back and self-pollinate. Emasculated flowers do not set fruit. Outcrossing seems to be encouraged by the exserted stigmas that remain exserted for nearly five hours, but fruit is insured by an effective system for self-pollination. Fruits mature in 23–29 days after anthesis.

DISCUSSION. *Malvastrum bicuspidatum* subsp. *bicuspidatum* is the northernmost taxon of the section *Tomentosum*, and is readily distinguished by its long-cuspidate, strongly ribbed mericarps, and its unique vesture patterns. Several authors have treated the species as a northern population of *M. tomentosum* (as *M. scabrum*, etc.) since the mericarps are superficially very similar. However, all of the Central American members of the section have lanceolate rather than linear-filiform bracteoles.

Individuals of the typical subspecies growing at the periphery of its range usually are more compact xerophytes. Plants grown with an abundance of water have larger leaves, and flower for longer periods with more elongated racemes. Individuals from Arizona most resemble individuals of *M. tomentosum* in South America in vesture characters of the leaves and mericarps and may represent an early “invasion-form”, but the plants have all of the diagnostic characters more typical of *M. bicuspidatum*.

REPRESENTATIVE SPECIMENS: **United States.** ARIZONA: Pima Co., Sierra Tucson, *Pringle 10787* (BR, F, G, GH, MICH, MO, NY, PENN, US, VT); Pinal Co., Devil's Canyon, near Superior, *Harrison 3094* (US). **Mexico.** SONORA: Agiabampo, *Palmer 790* (K, US); 12 mi. S of Ortiz, *Shreve 6111* (F); 16 mi. S of Hermosillo on road to La Palma, *Wiggins & Rollins 206* (DS, GH, MICH, MO, NY, TEX, UC, US); 4 mi E of Willard, between Hermosillo and Sahuaripa, *Wiggins & Rollins 290* (DS, GH, MICH, MO, NY, TEX, UC, US); Sierra Bojihuacame, SE of Cd. Obregon, steep slope, *Gentry 14522* (TEX, US); 14 mi. E of Navojoa, *Lehto et al. 19487* (pf); 19 mi S of Magdalena on road to Cucurpé, *Fryxell 3082* (pf); CHIHUAHUA: Arroyo La Bufa above río Batopilas, *Bye 6940* (pf); SINALOA: Culiacán, *Brandegees n.* (GH, POM, UC, US); Maraton, 12 mi W of Culiacán, *Gentry 7015* (DS, GH); BAJA CALIFORNIA: Comondú, *Brandegees n.* (F, PH, UC, US); San Bernardo Cañon, *Brandegees n.* (UC).

Figure 46. *Malvastrum bicuspidatum* subsp. *bicuspidatum* (holotype).



9b. ***Malvastrum bicuspidatum*** (S. Watson) Rose subsp. ***campanulatum*** S. R. Hill, *Brittonia* 32(4): 470. 1980. Fig. 47, 48.

TYPE: MEXICO. Hidalgo: near Tepejí del Río, alt. 7500 ft, on brushy hillside, 28 Oct 1972, *P. A. Fryxell & D. M. Bates 2175* (HOLOTYPE: BH!; ISOTYPES: CAS!, CTES, ENCB, pf!).

Suffruticose perennial (1.0) 1.5 (2.0) m tall, usually few-branched in the first year; *vesture* of all parts more dense than in subsp. *bicuspidatum*, stem with stellate hairs 0.3–2 mm diam with 6–8 rays; *cotyledons* wide-ovate, 9 mm in length $\times$ 10 mm in width, briefly emarginate at the apex, truncate or broadly rounded at the base, petiole ca. 4 mm long; *blades* 5–6 $\times$ longer than the petioles, ovate to narrowly ovate, rarely minutely 3-lobed $1/3$ the distance from the base, *vesture* of the adaxial surface generally of 5–6-rayed stellate hairs, only infrequently with 1–4- or more than 6 rays; *flowers* in few densely compacted racemes, often only one raceme the first year, 2–3-flowered axillary racemes generally lacking or few; *floral bracts* in the upper portions of the raceme deeply divided $1/2$ – $2/3$ to the base or with 3-lobed transitional forms, densely pubescent; *pedicels* not exceeding 1.5 mm, scarcely increasing in fruit; *involucl* bracteoles lanceolate, 5–7 mm long $\times$ 1.0–1.3 mm wide and densely pubescent, appearing ciliate; *calyx* lobed halfway to base, 9–10 mm from pedicel to lobe apex, shape in profile campanulate, lobes spreading to a lesser degree than in subsp. *bicuspidatum*, entire calyx densely pubescent with the outside surface obscured, margins of lobes ciliate; *petals* 10–12 mm long $\times$ 9 mm wide, darker orange than in subsp. *bicuspidatum* in cultivated plants; *androecium* with (49) 60–75 stamens (nearly 2 $\times$ that of other subsp.); *gynoecium* with (10) 12 (13) carpels, terminal subhemispherical stigmas exerted from the anthers by less than 1.0 mm, not expanded; *schizocarps*

Figure 47. *Malvastrum bicuspidatum* subsp. *campanulatum*. a. Habit, scale = 5 cm. b. Stamens, styles and stigmas, scale = 2 mm. c. Vesture of adaxial leaf surface, scale = 0.5 mm. d. Mericarp vesture, scale = 0.5 mm. e–g. Mericarp, lateral, distal and apical views, scale = 1 mm. h. Mericarp internal surface, scale = 1 mm. i. Fruit, apical surface, scale = 2 mm. j. Seed, lateral and apical views, scale = 1 mm. k. Calyx in fruit, profile, vesture excluded, scale = 1 mm. l. Columella and carpocrater, scale = 0.5 mm. m. Floral bracts, transitional above, fully developed below, scale = 2 mm. n. Stipule, scale = 2 mm. o. Bracteole, adnate portion stippled, scale = 2 mm. p. Leaf variation, mid-stem and apical leaves, scale = 2 cm. q. Cotyledon, scale = 5 mm. (a–h, j–l, n and q from progeny of *Waterfall & Wallis 13918*, i, m and o–p from *Fryxell, et al. 1624*).

7–8 mm diam; *mericarps* (10) 12 (13), 2.0 mm in height $\times$ 3.0 mm in length $\times$ 1.2 mm wide, with two distal-apical cusps (0.1) 0.5 (0.8) mm long, lateral faces only slightly ribbed, vesture similar to that of subsp. *bicuspidatum* but often with few simple hairs and generally shorter stellate hairs giving the surface a fine-canescence appearance, mericarp texture woody, endoglossum lacking; *seeds* with inconspicuous distal-apical sulcus; *chromosome number*: $n = 12$, $2n = 24$; *pollen* 53–79.4 (60) μm , *echinae* 3.8–5 μm , *apertures* 6–9.

DISTRIBUTION. (Fig. 44). Restricted to the semi-arid Mexican central high plateau (altiplanicies central), from eastern Jalisco in the west to southwestern Hidalgo in the east at elevations of 1200–2500 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering primarily in mid-August to November, but may bloom after rains into January and again in June. In cultivation (seeds from *Waterfall & Wallis 13918*) the flowers opened at least one hour after those of the typical subspecies (4–4:30 pm CST) and closed after sunset (7:30 pm CST), occasionally remaining open until the next morning. In cooler periods, a few flowers opened in the morning, 9:30 CST and closed at the usual time. Self-pollination may be common in native populations due to the close proximity of the anthers with the stigmas.

DISCUSSION. Especially diagnostic for this subspecies are the floral characters (e.g. numerous stamens, subequal styles, unexpanded stigmas), the derived mericarp features (such as the reduced cusps and ribbing), the vesture features, and the pronounced campanulate calyx. The latter feature, very conspicuous in living plants, was used as the basis of the subspecies epithet. It is thought that the reductional features and the nearly obligate autogamous reproduction are derived from the ancestral state seen in subsp. *bicuspidatum*.

SPECIMENS EXAMINED: **Mexico.** JALISCO: rocky hillside above lake Chapala near Tuxcueca, *Leavenworth & Leavenworth 1910* (F); GUANAJUATO: near Guanajuato, *Kenoyer 1744* (A); 59 mi. SE of Salamanca, *Waterfall & Wallis 13918* (F, SMU); QUERÉTARO: Palobobo valley NW of Querétaro, *Gregg 594* (GH, MO, NY); Querétaro, *Berlandier 1290* (GH); 10 km. N of Querétaro, *Flores-Crespo 346* (ENCB,



U. S. Department of Agriculture
Agricultural Research Service — Crops Research Division
Cotton Branch Herbarium

Malvastrum discoloratum (L. var.) Sims

PLANT: DISCOLOR near Tepic del Rio, on brushy
slopes; alt. 7500 ft. shrub to 5 ft tall,
flowers yellow.

Collector: P. Rydell & D. Bates

Date: 10 October 1972

No. 2175

HERBARIUM
OF
P. A. RYDELL

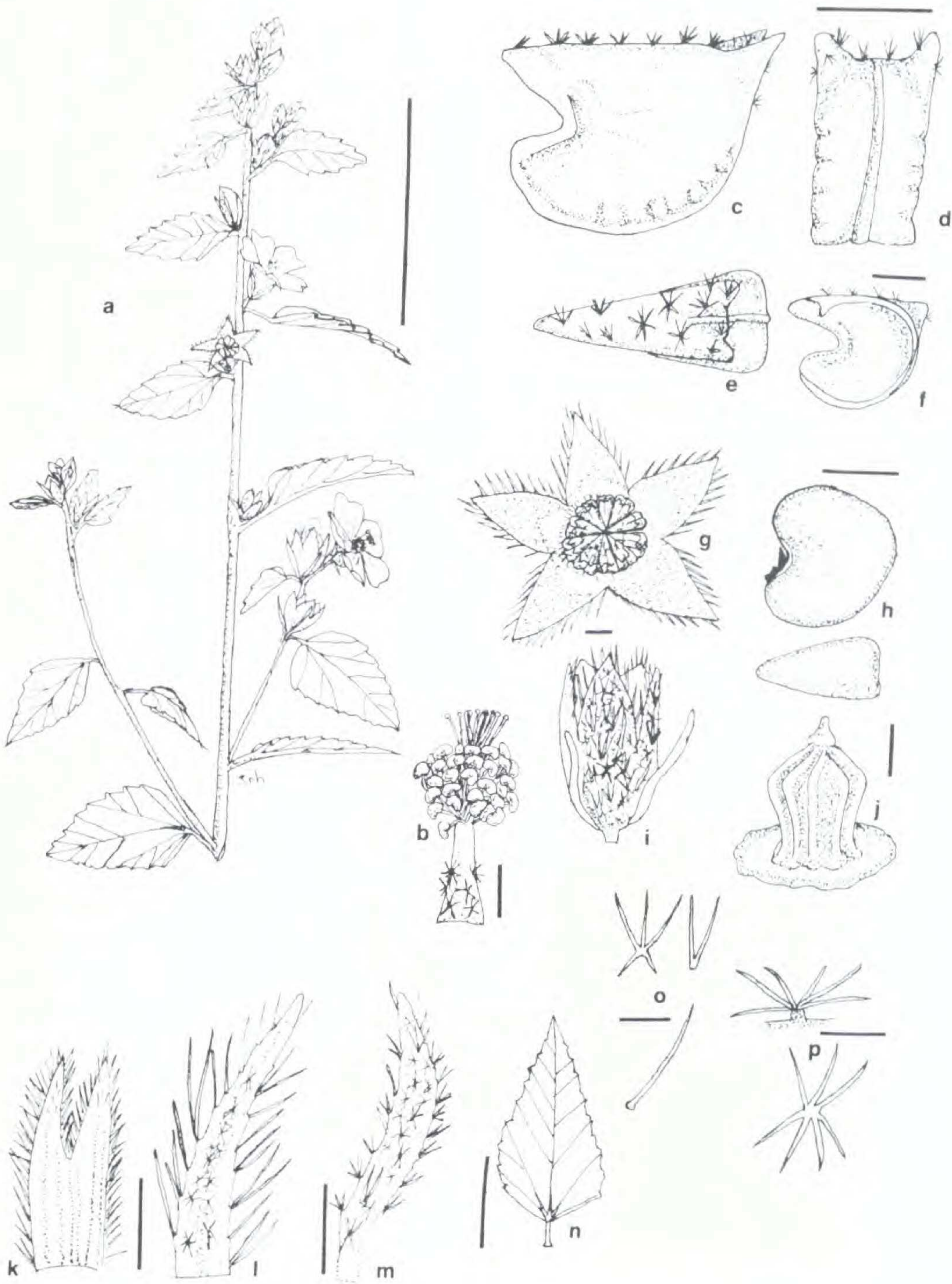
MICH, pf); 7 mi. N of Querétaro, *Fryxell* 770 (BH, CTES, MEXU, pf, SASK, UC, US); Hwy. 57, N of Querétaro across from Pemex Station, *Dunn & Dunn* 18480 (MO, pf); HIDALGO: near Tepeji del Río, *Fryxell & Bates* 2175 (BH, CAS, pf); MICHOACÁN: 15 mi. E of Jiquilpan, *Fryxell et al.* 1624 (BH, pf); Monte León, *Pringle* 13851 (collected Lozano) (CAS, GH, MICH, SMU, US, VT).

- 9c. ***Malvastrum bicuspidatum* (S. Watson) Rose subsp. *oaxacatum***
 S. R. Hill, *Brittonia*, 32(4): 478. 1980. TYPE: MEXICO. Oaxaca:
 Monte Albán, Oaxaca City, 5 Sep 1894, C. G. *Pringle* 5778
 (HOLOTYPE: VT!; ISOTYPES: C!, GH!, US!) Fig. 49, 50.

Malvastrum oxacatum Rose ex Davis, *Life and Work of C. G. Pringle*: 405.
 1936, nomen nudum. A manuscript name.

Sparsely branched compact suffruticose perennial, stem hairs somewhat tuberculate; *leaf blades* 25–40 mm long $\times$ 15–20 mm wide, ovate-lanceolate, occasionally briefly 3-lobed 1/3 the distance from the base, vestiture of the adaxial surface of stellate (2) 5–6-rayed hairs and simple hairs in the Puebla population and of simple or 2-rayed hairs in the Oaxaca population, the vestiture of the abaxial surface dense with 10–12-rayed stellate hairs, leaves paler beneath; *flowers* in congested terminal racemes, solitary-axillary in leaf axils at first and not infrequently in several reduced racemes from upper leaf axils; *calyx* conspicuously ciliate; *petals* 10–14 mm long $\times$ 8–10 mm wide; *stigmas* exerted from the anther cluster by 2 mm; *mericarp* similar to that of subsp. *tumidum* in its leathery texture, but with a firm proximal-apical endoglossum on the internal surface, external surface at apex pubescent with small stellate hairs 0.5 mm or less long, pericarp surfaces smooth except for ribs at the distal-lateral margins giving margins a crenate appearance in profile, raised midline present on distal-apical surface, *seeds* symmetrically reniform, without a sulcus; *chromosome number*: $2n = 24$; *pollen* 59–79.4 (68.7) μm diam, *echinae* 2.6–3.8 μm , *apertures* 6–9 (usually 7).

Figure 49. *Malvastrum bicuspidatum* subsp. *oaxacatum*. a. Habit, scale = 5 cm. b. Stamens, styles and stigmas, scale = 2 mm. c–e. Mericarp, lateral, distal and apical views, scale = 1 mm. f. Mericarp, internal view, scale = 1 mm. g. Fruit, apical view, scale = 2 mm. h. Seed, scale = 1 mm. i. Calyx, early fruit, scale = 2 mm. j. Columella and carpocrater, scale = 0.5 mm. k. Floral bract, scale = 2 mm. l. Stipule, scale = 2 mm. m. Bracteole, scale = 2 mm. n. Leaf, scale = 2 cm. o. Adaxial leaf vestiture, scale = 0.5 mm. p. Stem vestiture, scale = 0.5 mm. (a, c–e, g, j–m and p from *Smith* 644; b, i and n–o from *Pringle* 5778; f and h from *Krapovickas & Cristóbal* 23596.)



DISTRIBUTION. (Fig. 44). Known only from Coxcatlan, Puebla and Monte Albán, Oaxaca on semi-arid slopes at an altitude of 1800–2600 m and is probably to be found at suitable sites in between.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. According to specimen labels, plants were in flower from early September to early November and in fruit into January. Daily flowering periods are not known. The exerted stigmas suggest effective cross-pollination, but the populations may be small and inbred.

DISCUSSION. *Malvastrum bicuspidatum* subsp. *oaxacatum* grows in some of the most arid portions of the range of the species. In such regions its thick indument might aid in water conservation. The presence of an endoglossum and absence of simple hairs on the mericarp readily distinguish this subspecies from the others in *M. bicuspidatum*. The texture of the pericarp and the mature inflorescence habit ally it with subsp. *tumidum*. The endoglossum is probably retained here by chance and again demonstrates the affinity of *M. bicuspidatum* with *M. tomentosum*. I have chosen Rose's invalid but appropriate specific epithet as the basis of the subspecific epithet.

SPECIMENS EXAMINED: **Mexico.** PUEBLA, Coxcatlan, *Purpus 4185* (GH, NY, UC, US); OAXACA: Monte Albán, *Smith 644* (CAS, F, MO, NY, RSA, UC, US); Monte Albán, *Krapovickas & Cristóbal 23596* (pf); Monte Albán, *Krapovickas 8215* (G).

9d. ***Malvastrum bicuspidatum*** (S. Watson) Rose subsp. ***tumidum*** S. R. Hill, var. ***tumidum***, *Brittonia* 32(4): 474. 1980. TYPE: MEXICO. Jalisco: Valley of Tequila, 27 Sept 1893, C. G. Pringle 5452 (HOLOTYPE: VT!; ISOTYPES: F!, GH!, MICH!, MO!, US!). Fig. 51, 52.

Suffrutescent perennial 1.0–2.0 m tall, frequently branching in the upper third; *stem and branches* as in subsp. *campanulatum*, branches apparently short; *cotyledons* not known; *blades* tending to be ovate-elliptic, with an adaxial vestiture of fine simple hairs 1–1.5 mm long imparting to the leaf a felty texture, the few stellate hairs restricted to the base on lower veins or to apical leaves, abaxial

Figure 50. *Malvastrum bicuspidatum* subsp. *oaxacatum* (holotype).



C. G. PRINGLE,
PLANTÆ MEXICANÆ.
5778 STATE OF OAXACA
Malvastrum oaxacanum,
Monte Alban, Oaxaca,
5 Sept., 1894.



vesture loose, of 5–8-rayed hairs; *flowers* borne on several reduced floriferous branches in the axils of upper leaves even in young plants, the leafless portion of the raceme less than 10 cm long, the flowers somewhat congested; *floral bracts* lobed halfway to the base, 2.5 mm long $\times$ 2.5 mm wide; *pedicels* 1–3 mm, scarcely increasing in fruit; *involucl* as in the typical subspecies but strigose-pubescent with a ciliate margin; *calyx* divided $1/2$ to $2/3$ to the base, with a somewhat campanulate base and slightly spreading lobes, external surface varying from sparsely to densely pubescent, the margins of lobes conspicuously ciliate with simple hairs 1–1.5 mm long in contrast to the typical subspecies; *petals* 7–10 mm long $\times$ 8 mm wide; *androecium* with 38–49 stamens, tending towards 40; *gynoecium* with 10–11 carpels, stigmas expanded hemispherical, exserted 1–2 mm above the anther cluster; *schizocarps* 6–8 mm diam; *mericarps* 10–11, often tinted rose drying to red-brown or brown, 2.0 mm in height $\times$ 3.0 mm in length $\times$ 1.0–1.5 mm in width appearing swollen, with 2 apical-distal cusps 0.8–0.9 mm long, lateral faces unribbed, somewhat shiny, apical-distal surface with a conspicuous raised medial line, vesture consisting of a few fine simple or 2–3-rayed hairs 0.5–1.0 mm long or with a few minute 2–5 rayed stellate hairs 0.2 mm diam, restricted to the apical and cusp surfaces, lateral and distal surfaces glabrous, pericarp flexible leathery or chitinous, endoglossum lacking; *seeds* 1.5–2 mm long $\times$ 2 mm in height $\times$ 0.8 mm in width with a very inconspicuous distal-apical sulcus or this absent; *chromosome number*: not known; *pollen* 66.6–79.4 (74.5) μ m diam, echinae 3–5 μ m, apertures 6–9.

DISTRIBUTION. (Fig. 44) Restricted to the transverse volcanic belt of Mexico between 1200–1900 m elevation, from Jalisco to Michoacan and Morelos.

Figure 51. *Malvastrum bicuspidatum* subsp. *tumidum* var. *tumidum*. a. habit, scale = 5 cm. b. Stamens, styles and stigmas, scale = 2 mm. c–e. Mericarp, lateral, distal and apical views, scale = 1 mm. f. Mericarp, internal view, scale = 1 mm. g. Fruit, apical view, including vesture of single lobe, scale = 2 mm. h. Seed, lateral and apical views, scale = 1 mm. i. Fruiting calyx profile, excluding vesture, scale = 2 mm. j. Columella and carpocrater, scale = 0.5 mm. k. Floral bract, scale = 2 mm. l. Stipule, scale = 2 mm. m. Bracteole, scale = 2 mm. n. Stem vesture, scale = 5 mm. o. Adaxial leaf vesture, scale = 0.5 mm. p. Abaxial leaf vesture, scale = 0.5 mm. (a, c–e and g–p from Fryxell & Bates 2143; b and f from Pringle 5452.)



Figure 52. *Malvastrum bicuspidatum* subsp. *tumidum* var. *tumidum* (holotype).

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering primarily in September to November. Daily flowering time not known.

DISCUSSION. The leathery nearly glabrous swollen and often rose-tinted mericarps of *Malvastrum bicuspidatum* subsp. *tumidum* are its primary diagnostic features. Vegetative and inflorescence characters closely resemble the corresponding characters in *M. guatemalense*, but the mericarps are very different. *Malvastrum bicuspidatum* subsp. *tumidum* is the most mesophytic of the subspecies as reflected in the larger wider leaves and generally sparse vestiture on vegetative parts. It is apparently well-adapted to the fertile soils of the volcanic belt in regions with moderate rainfall. It is suspected that seeds of this subspecies are dispersed by birds, a change from the probable ancestral mammalian dispersal mode; this conclusion is based on the reduction of transport mechanisms and pericarp strengthening features (such as the ribs), and on the rose-red color of the young mericarps.

SPECIMENS EXAMINED: **Mexico.** JALISCO: Valley of Tequila, *Pringle* 5452 (F, GH, MICH, MO, US, VT); 15 km. W. of Ayutla towards Cuautla, *Fryxell & Bates* 2143 (BH, MEXU, MICH, pf); 2 mi S of Jocotepec on Route 15, *Harker & Mellowes* 33 (BM); Ixtlahuacan de los Membrillos, *Detling* 8753 (MICH); MICHOACAN: mountain above Lake Chapala near KM 543, 8 mi NW of Sahuayo, *McVaugh* 18147 (MICH, US); MORELOS: Iturbide, Cuernavaca, *Bourgeau* 1170 (GH); near Cuernavaca, *Rose & Hough* 10246 (GH, US).

- 9e. ***Malvastrum bicuspidatum*** (S. Watson) Rose subsp. ***tumidum*** S.R. Hill var. ***glabrum*** S. R. Hill, *Brittonia* 32(4):476. 1980. TYPE: MEXICO: Michoacan: Between Tuxpan and Ciudad Hidalgo, 3 miles north of Tuxpan, alt. 5700 ft, October 14, 1970. *P. A. Fryxell, D. M. Bates & O. Blanchard* 1642 (HOLOTYPE: BH!; ISOTYPES: CTES, ENCB, pf!). Fig. 53, 54.

Very similar to the typical variety of subsp. *tumidum* but differing in its more narrowly ovate-lanceolate leaves, (some of which are 8 times longer than the petioles), in the erect calyx lobes in fruit, and in its smaller glabrous schizocarps ca. 5.0 mm in diameter that are bright red apically when mature, the color fading slightly upon drying; *chromosome number*: not known; *pollen*: 71.7–79.4 (75.9) μ m diam, echinae 3.8 μ m, apertures 7–8.

DISTRIBUTION. (Fig. 44) Known only from the type locality 3 miles north of Tuxpan, Michoacan, Mexico.



PHENOLOGY AND REPRODUCTIVE BIOLOGY. The type specimen was in flower and with young fruit when collected in mid-October; daily flowering period not known.

DISCUSSION. Glabrous mericarps are found in no other species of *Malvastrum*, and so this new variety is considered to be noteworthy. It occurs at a point of contact between the ranges of *M. bicuspidatum* subsp. *campanulatum* and *M. bicuspidatum* subsp. *tumidum* var. *tumidum*, but has no hybrid characters.

SPECIMENS EXAMINED. **Mexico.** MICHOACAN: between Tuxpan and Ciudad Hidalgo, 3 mi north of Tuxpan, alt. 5700 ft, *Fryxell et al.* 1642 (BH, pf).

Section 5. *Amblyphyllum*

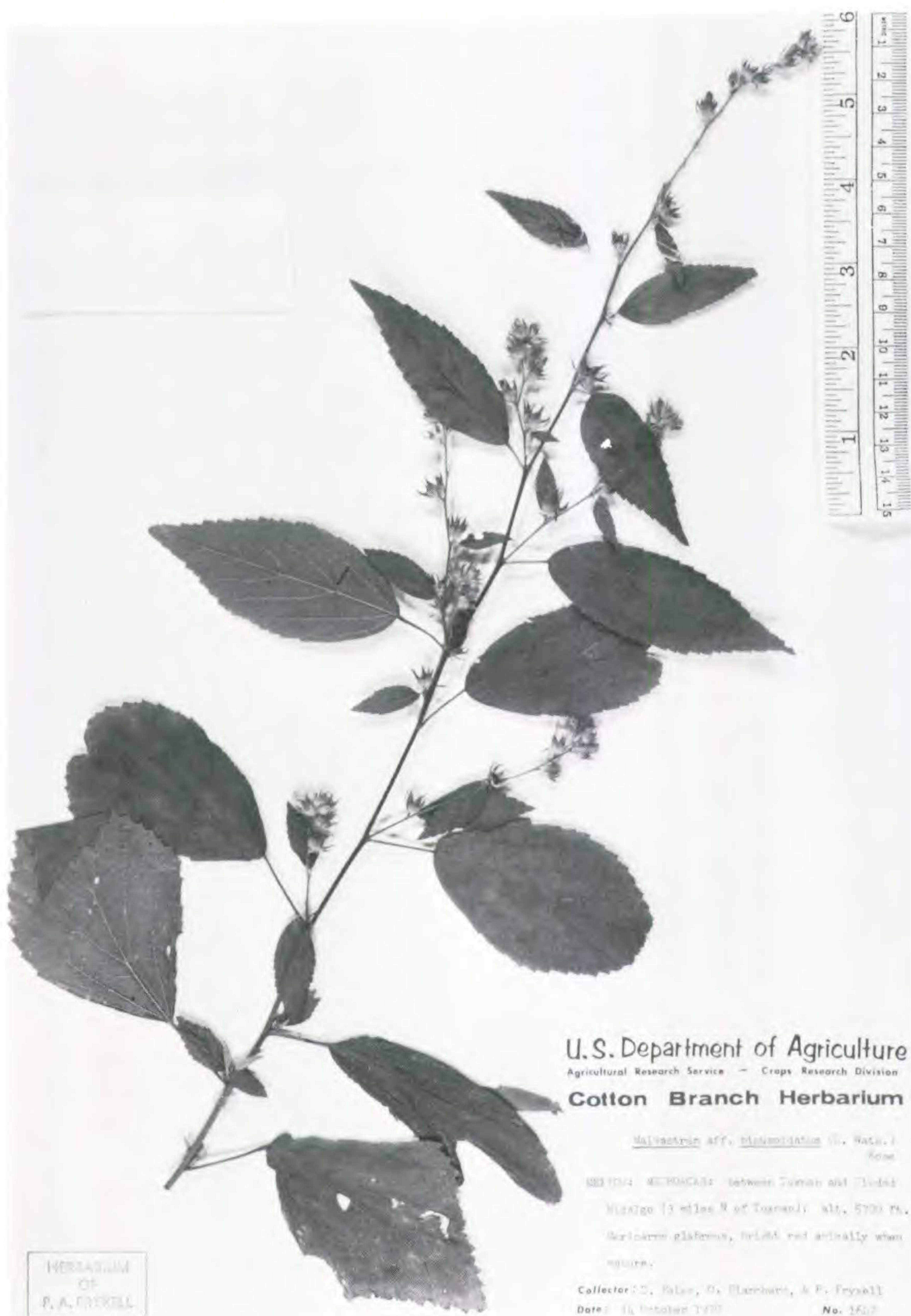
Malvastrum* sectio *Amblyphyllum* S. R. Hill, *sect. nov.

Carpella matura 11–18, indehiscentia, superficie apicali pilis simplicibus, muris lateralibus pericarpium crassis et costatis, cuspidibus 2 distali-apicalibus 0.5–1.5 mm longis et cuspidem unico proximali-apicali 0.1–1.0 mm longo ornata, marginibus pericarpium distalibus alatis, endoglosso nullo; stamina 26–111, columna staminali pubescenti; flores solitarii axillares ad apicem conferti; bracteolae involucelli basi ad calycem adnatae vel liberae; bracteae florales bifidae nullae; pili caulini nunquam stipitati; pollinis grana aperturis 15–35. Typus: *Malvastrum amblyphyllum* R. E. Fries

The solitary axillary flowers, indehiscent, thick-walled elaborately ribbed and marginally winged mericarps, lack of an endoglossum and bifid floral bracts, pubescent filament tube, and 15–35 aperture pollen characterize the section *Amblyphyllum*.

10. ***Malvastrum grandiflorum* A. Krapovickas, Bol. Soc. Argent. Bot. 15 (4): 467, f. 1. 1974. TYPE: BOLIVIA. Tarija: Ysry, 40 km.**

Figure 53. *Malvastrum bicuspidatum* subsp. *tumidum* var. *glabrum*. a. Habit, scale = 5 cm. b–d. Mericarp, lateral, distal and apical views, scale = 1 mm. e. Mericarp, internal view, scale = 1 mm. f. Calyx in fruit, vesture of one lobe only, scale = 2 mm. g. Floral bract, abaxial surface, scale = 2 mm. h. Stipule, abaxial surface, scale = 2 mm. i. Bracteole, abaxial surface, scale = 2 mm. j. Leaf, scale = 2 cm. k. Stem vesture, scale = 0.5 mm. l. Leaf adaxial surface vesture, scale = 0.5 mm. m. Leaf abaxial leaf surface vesture, scale = 0.5 mm. (All from *Fryxell et al.* 1642.)



HERBARIUM
OF
P. A. FRYXELL

U. S. Department of Agriculture
Agricultural Research Service — Crops Research Division
Cotton Branch Herbarium

Malvestrum aff. pinnatifidum (L.) Wats. f.
Rose

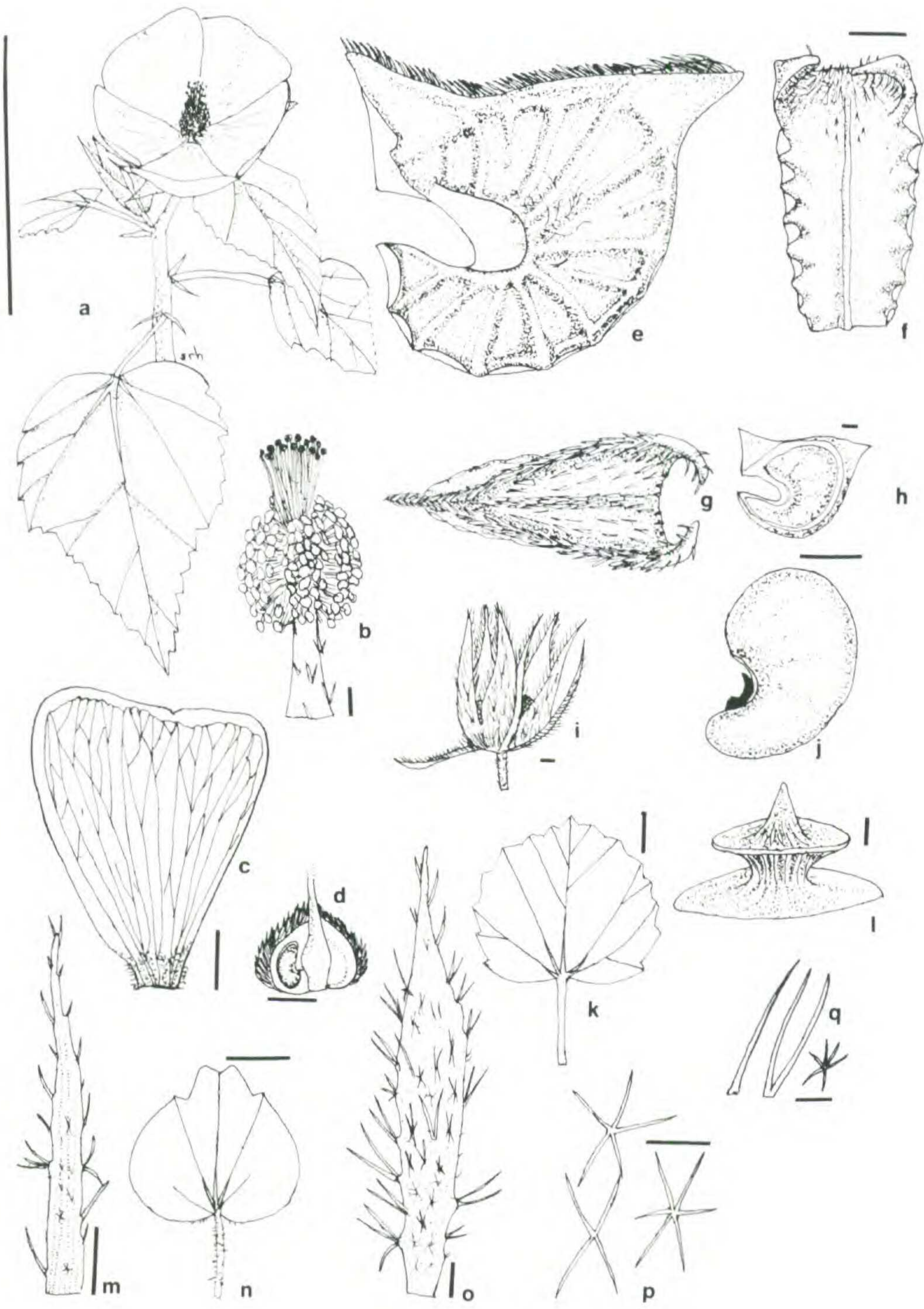
SEEDLING: MICHIGAN: between Tawas and Tawas
Michigan (3 miles N. of Tawas); alt. 5700 ft.
Sericeous glabrous, bright red axially when
mature.

Collector: C. Palmer, O. Elmhurst, & P. Fryxell
Date: 14 October 1933 No. 1657

W of Villa Montes on road to Tarija, altitude 500 meters, May 26, 1971. A. Krapovickas, L. A. Mroginski, and A. Fernández 19300 (HOLOTYPE: CTES; ISOTYPES: BA, BAA, BAB, BH!, G!, GH!, K!, LIL, LP, NY!, P, pf!, SI, UC, US!) Fig. 55, 56.

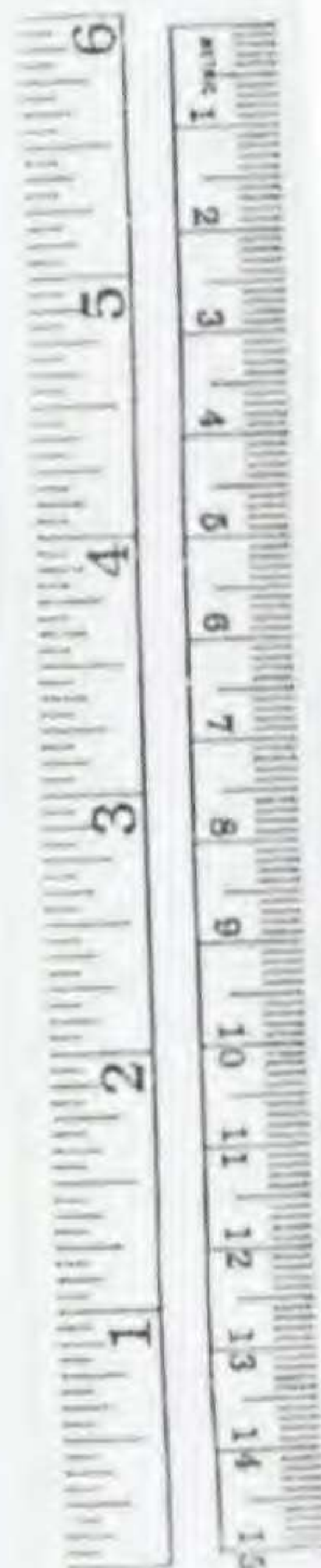
Suffruticose sparsely branched *perennial* herb 1.7 m tall; main stem 4–8 mm diam at base, with primary branches 20–60 cm long vesture of appressed non-persistent (4) 5–6 (7)-rayed stellate hairs 0.6–1.0 mm diam slightly overlapping on young branches and sparse on older branches; *cotyledons* 9 mm long $\times$ 11 mm wide, wide-ovate, 3-lobed, emarginate at the apex and slightly cordate at base, palmately 5-nerved; *stipules* (7) 10–16 mm long $\times$ 1.0–1.5 mm wide, narrowly-lanceolate, subfalcate, long-acuminate; *petioles* (5) 20–50 (60) mm long; *blades* 1.6–2.6 $\times$ longer than the petioles, ovate, unlobed to obscurely 3-lobed $1/2$ to $2/3$ the distance above the base, base slightly cordate broadly rounded to somewhat truncate, apex acute to acuminate, seedling leaves sub-orbicular or sometimes wider than long with a cordate base and rounded apex, blades (30) 70–90 (130) mm long $\times$ (20) 50–70 (85) mm wide, average midstem blade 1.3–1.5 $\times$ longer than wide, margins dentate to sharply dentate with 1.5–3 teeth/cm, vesture of the adaxial surface of evenly scattered (5) 6 (8)-rayed stellate hairs 0.3–1.0 mm diam with a few enlarged apically or marginally directed rays, abaxial vesture dense with similar 8–10-rayed hairs not obscuring the leaf epidermis; *flowers* solitary-axillary, later aggregated in terminal spicate racemes subtended by reduced leaves and their stipules, the congested appearance owing to shortening of the internodes; *pedicels* 2–4 mm long increasing 1 mm or less in fruit; *involucl* of 3 lanceolate to narrowly lanceolate, subfalcate bracteoles (15) 17–18 mm long $\times$ 2.5–3.0 mm wide, free from the calyx or slightly adnate in basal 1.0 mm; *calyx* united $1/5$ to $1/3$ its length, 15 mm from pedicel to apex in flower and 20 mm in fruit, slightly accrescent, broadly campanulate at anthesis and narrowly campanulate in fruit, lobes slightly spreading in flower and erect in fruit, narrowly triangular, acuminate, 12–15 mm long $\times$ 5–6 mm wide, somewhat tomentose on the outside with sparse simple or 2-rayed hairs 2 mm long directed apically and dense 4–8-rayed stellate hairs 0.5 mm

Figure 54. *Malvastrum bicuspidatum* subsp. *tumidum* var. *glabrum* (isotype, pf).



diam usually obscuring the surface, lobes pubescent within on upper 2/3 with sparse minute simple hairs; *corolla* to 47 mm diam when spread, golden-yellow to yellow-orange, petals slightly asymmetrically bilobed, 17–23 mm long $\times$ (12) 15 mm wide, widespread at anthesis, exceeding the calyx by 4–5 mm, claws red, slightly pubescent marginally with fine simple hairs 0.5 mm long; *androecium* with 108–111 stamens in 5 longitudinal rows, filament tube 6–7 mm long, sparsely pubescent with minute 2–4-rayed hairs, free portion of filaments 1.5–2.0 mm long, anthers 1.3–1.5 mm long $\times$ 0.8 mm wide after dehiscence; *gynoecium* with (13) 16–18 loosely coherent carpels, style branching 8 mm above the columella, each branch terminated by an enlarged hemispherical magenta stigma conspicuously raised above the anthers by 3–5 mm, ovary surface densely pubescent with simple ascending centrally directed hairs; *schizocarps* 8 mm diam including ornamentation; *mericarps* (13) 16–18, 3.0–3.5 mm in height $\times$ 4–5 mm in length including ornamentation $\times$ 2.0 mm in width, usually with a fragile flattened proximal-apical cusp 1.0 mm long and two flattened distal-apical cusps 1.0–1.5 mm long the latter distinctly separate but curved towards one another, lateral faces with conspicuous opaque ribs extending into a thin translucent slightly winged border extending 0.1–0.3 mm from the mericarp body, distal surface with a conspicuous raised medial line, vesture on the apical surface primarily of strigose coarse rigid proximally directed simple hairs 0.5–0.7 mm long with a few simple downy hairs on the central portion of the lateral faces and near the apex of the distal surface, pericarp woody and indehiscent, the proximal-apical region thin and solid, endoglossum lacking, tardily deciduous from the receptacle at maturity due to the enclosing calyx lobes; *seeds* narrower in the basal half below the hilum, 2.5 mm in height $\times$ 2.0

Figure 55. *Malvastrum grandiflorum*. a. Habit, scale = 5 cm. b. Stamens, style, and stigmas, scale = 2 mm. c. Petal, scale = 5 mm. d. Ovary at anthesis, carpel dissected to show ovule, scale = 1 mm. e.–g. Mericarp, lateral, distal, and apical views, scale = 1 mm. h. Mericarp, internal view, scale = 1 mm. i. Calyx in fruit, scale = 2 mm. j. Seed, scale = 1 mm. k. Seedling leaf, scale = 1 cm. l. Columella and carpocrater, scale = 0.5 mm. m. Stipule, scale = 2 mm. n. Cotyledon, scale = 5 mm. o. Bracteole, scale = 2 mm. p. Stem vesture, scale = 0.5 mm. q. Calyx vesture, scale = 0.5 mm. (All drawn from cultiv. progeny of Krapovickas et al. 19300).



Salviastrum grandiflorum 19-25. 1974

PLANTAS DE BOLIVIA

Salviastrum grandiflorum Krap.
Isotipo

Nº. 19300

Dep. Tarija

Loc. Ruta Tarija - Villa Montes, Ysyry, 500m s.m., 40 Km W de
Villa Montes

Obs.

Leg. A. Krapovickas, I. A. Mroginiski y A. Fernandez 26-V-1971

HERBARIUM
OF
P. A. FRYXELL

mm in length $\times$ and 0.6–0.8 mm in width, seed coat often with slight ridges corresponding with the ribs on the mericarp surface; *chromosome number*: $2n = 24$; *pollen* 69–104 (90) μm diam, *echinae* 6–7 μm , apertures 24–35.

DISTRIBUTION. (Fig. 57) Known only from the type locality in the highland Chaco region of southern Bolivia, Department of Tarija, between 28 and 40 km west of Villa Montes at an elevation of 500–560 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering April–June where native, it was in flower and fruit when collected in May (local autumn). In cultivation in Texas, a seed from the type germinated five days after planting. The single plant flowered in July, 60–70 days after seed germination, then again more frequently in September–October (local late summer and autumn). The flowers opened at 10–10:30 CST and remained open until sunset (7 pm CST), a duration of 9 hours which was the longest duration of any of the species under cultivation. The stigmas remained erect and did not recurve as the flower wilted, so that in the absence of pollinators the flowers did not self-pollinate. Flowers not artificially pollinated in the greenhouse did not set fruit; those that were pollinated by hand had $< 5\%$ fruit set and all seeds were inviable.

There may be incompatibility mechanisms at work. The few fruits required 30 days to mature after pollination.

The large flowers with conspicuous nectar-guides, the long duration of anthesis (for the genus), the lack of self-pollination mechanisms, and the poor seed set when artificially self-pollinated suggest a strong reliance on insect cross-pollination in its native habitat.

DISCUSSION. *Malvastrum grandiflorum* is the showiest and one of the most distinctive species of the genus. With regard to vegetative and mericarp features it can be seen to be very closely allied to *M. amblyphyllum*. Its restricted range, compared with the range of *M. amblyphyllum*, is probably a result of its dependence on insect vectors and nearly total self-incompatibility. Whether or not it once had a formerly more extensive range cannot be determined, but it does seem to be more ancient than *M. amblyphyllum* which has

many derived floral characters. As in *M. amblyphyllum*, *M. grandiflorum* has not reached the point of floral bract specialization, and produces fewer fruits than most of the other species in the genus.

SPECIMENS EXAMINED. **Bolivia**, TARIJA: Ysyry, 40 km. W of Villa Montes on the road to Tarija, alt. 500 m, *Krapovickas et al.* 19300 (BH, G, GH, K, NY, pf, UC, US).

11. ***Malvastrum amblyphyllum*** R. E. Fries, *Ark. Bot.* 6(2): 6, t. 2, f. 9–10. 1906. TYPE: BOLIVIA. Tarija: Fortín (Colonia) Crevaux at the Río Pilcomayo, in open woodland, April 18, 1902. *R. E. Fries* 1610 (HOLOTYPE: s!, ISOTYPE: s!). *Malvastrum scabrum*

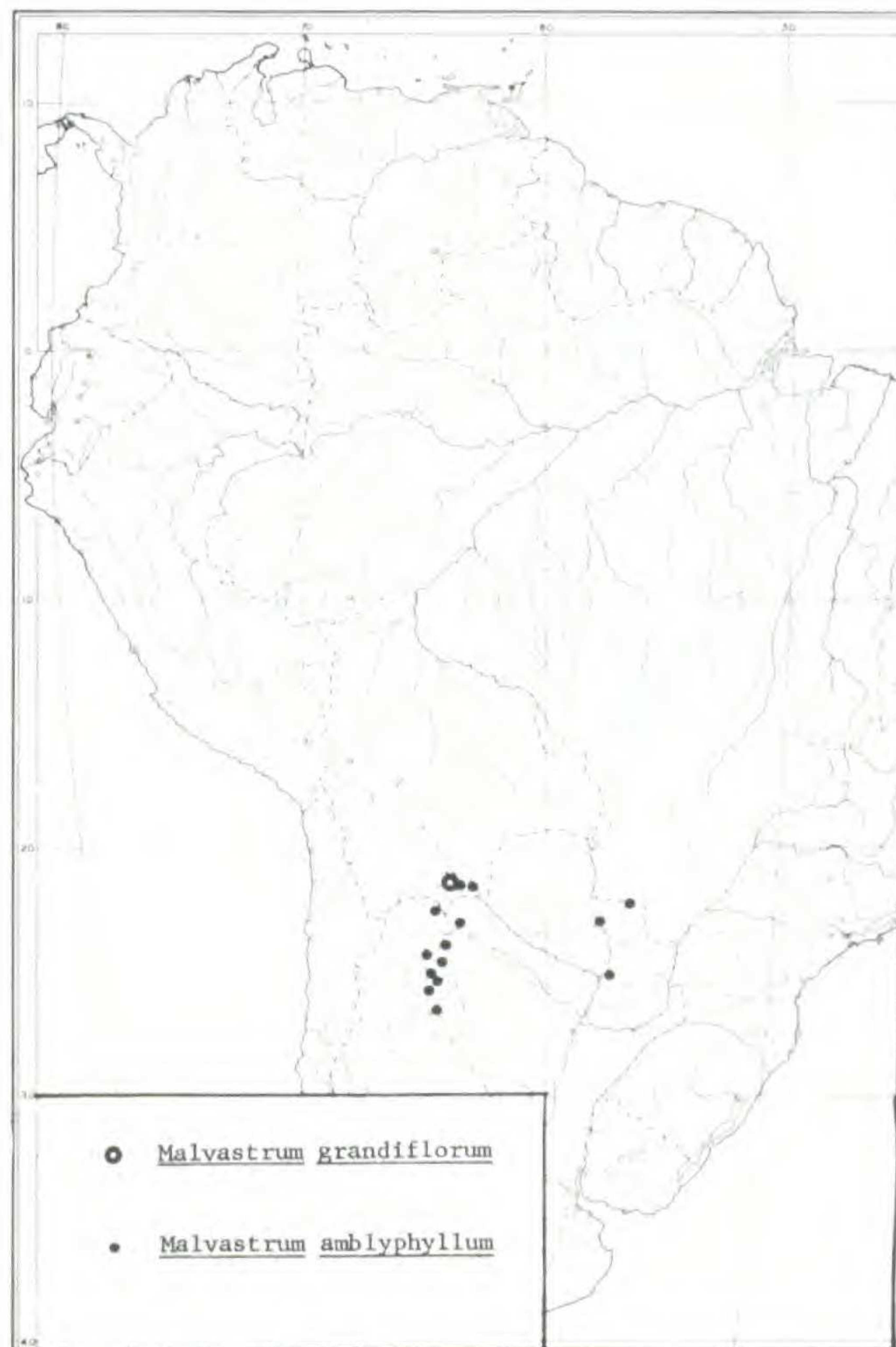


Figure 57. Distribution of *Malvastrum grandiflorum* and *M. amblyphyllum*.

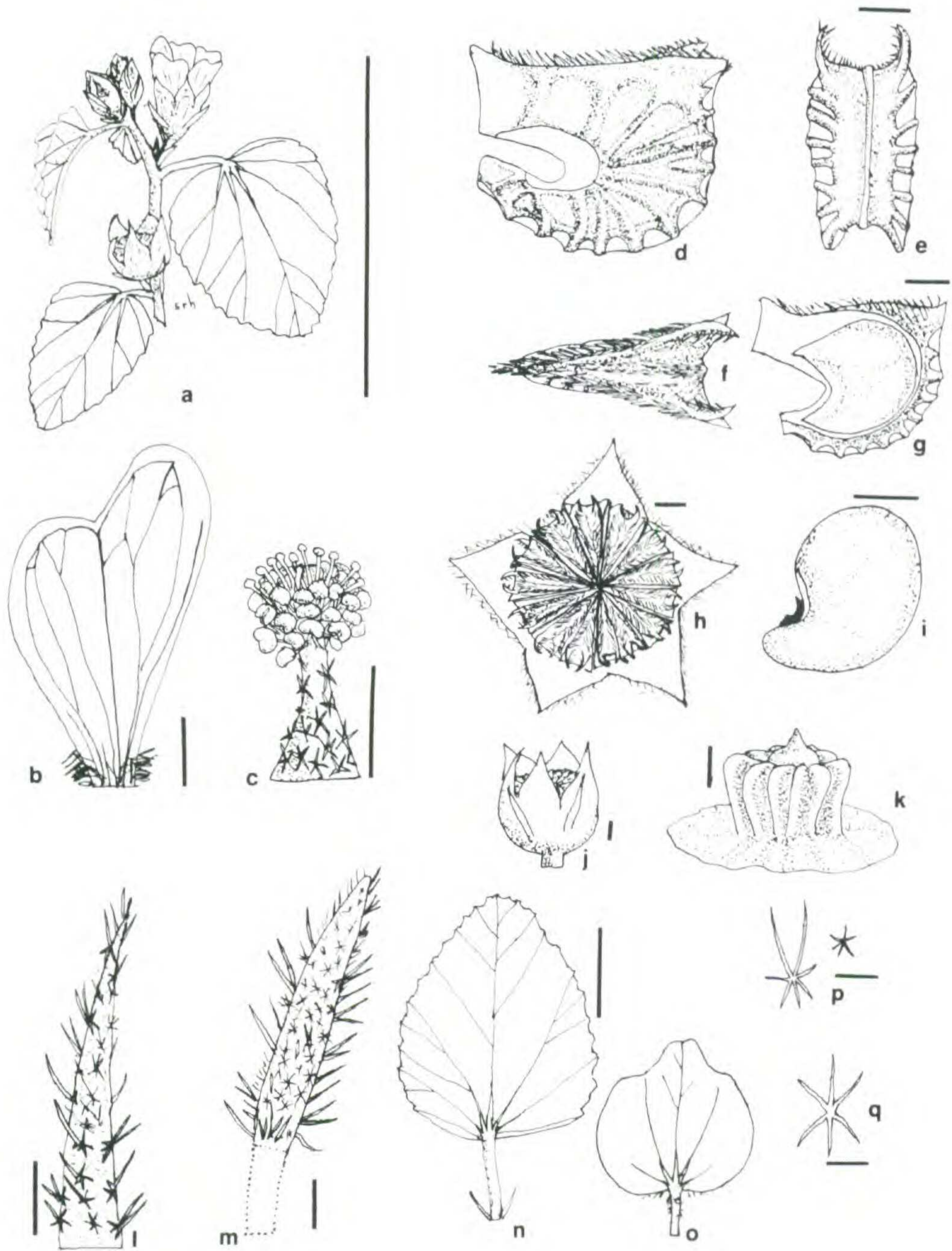
(Cavanilles) A. Gray var. *amblyphyllum* (R. E. Fries) E. Hassler, Feddes Repert. Spec. Nov. Regni Veg. **12**: 366. 1913 (“*amblyphyllum*”). Fig. 58, 59.

Malvastrum scabrum var. *paraguariense* E. Hassler, Feddes Repert. Spec. Nov. Regni Veg. **8**: 34. 1910. TYPE: PARAGUAY. “In colle calcareo pr. flumen Apa”, May, 1887. *E. Hassler* 21 (HOLOTYPE: G!).

Malvastrum scabrum (Cavanilles) A. Gray var. *tucumanense* E. Hassler, Feddes Repert. Spec. Nov. Regni Veg. **12**: 365. 1913. TYPE: ARGENTINA. Tucumán: District of Burayacú. Cañada Alegre, March 12, 1909. *S. Gonzalez* 19935a (HOLOTYPE: G!; ISOTYPES: CORD, G! LIL).

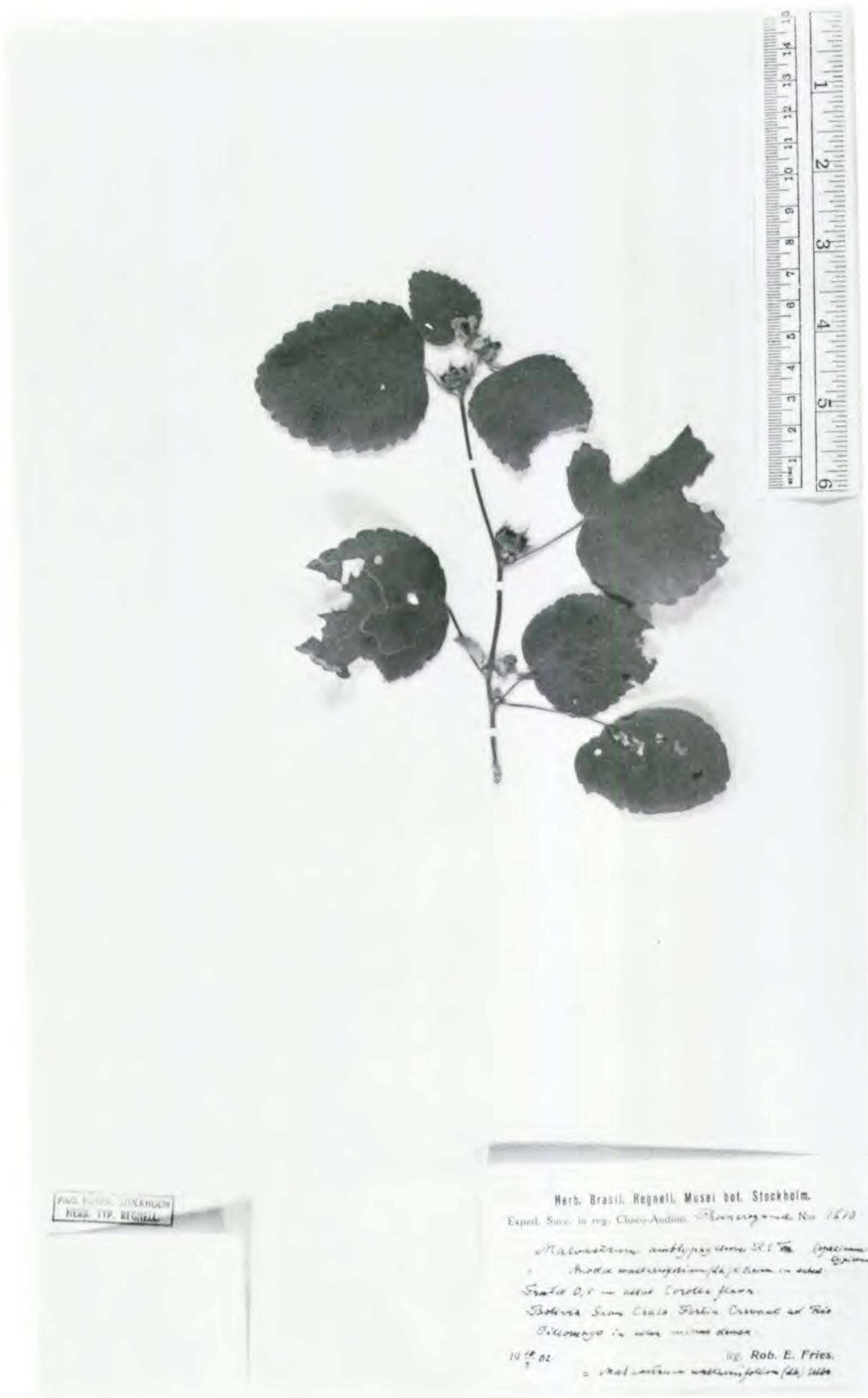
Malvastrum waltheriifolium sensu Ulbrich, pro parte, Feddes Repert. Spec. Nov. Regni Veg. **13**: 510. 1915, excl. basionym. Ulbrich cites *Fries* 1610, the type of *M. amblyphyllum* as representative. *Anoda waltheriifolia* Schumann ex Ulbrich, loc. cit., excl. basionym.

Suffruticose sparsely branched perennial herb to 1.2 m tall or stunted to 0.3 m; main *stem* 5–10 mm diam at base; *branches* to 35–40 cm long, stem vesture loose to dense of (4) 5 (6)-rayed stellate hairs 1.0–1.5 mm diam; *cotyledons* 9 mm long $\times$ 9 mm wide, wide-ovate, emarginate-cuspidate at the apex, subtruncate to slightly cordate at the base, palmately 5-nerved; *stipules* (3) 4–5 (7) mm long $\times$ (0.4) 0.5 (0.8) mm wide, narrowly lanceolate to linear, acuminate; *petioles* (7) 20–35 (45) mm long; *blades* 2–2.5 $\times$ longer than the petioles, (25) 30–70 (82) mm $\times$ (18) 40–60 (80) mm wide, average midstem blade 1.2–1.4 $\times$ longer than wide, ovate to wide-ovate, young blades often wider than long, unlobed, base truncate broadly cuneate to slightly cordate, apex rounded to slightly acute, margin crenate-dentate with 3–4 teeth/cm, vesture of the adaxial surface loose to dense with 6-rayed stellate hairs, abaxial vesture of more dense (6) 8–10 (12)-rayed hairs; *flowers* solitary in axils of upper leaves and stipules or on short 2–4-flowered axillary branches or terminal spicate racemes with shortened internodes; *pedicels* (0.5) 1–2 (5) mm long increasing typically from 1 mm at anthesis to 4 mm in fruit; *involucl* of 3 narrowly lanceolate to linear bracteoles (5) 6–7 (8) mm long $\times$ (0.5) 1.0 mm wide, united to calyx 1.5 mm below; *calyx* united 1/4 to 1/3 its length, 7–8 mm from pedicel to lobe apex to 9–11 mm in fruit, somewhat narrowly campanulate at anthesis, lobes erect, deltate, acuminate-cuspidate, (5) 7–8 (9) mm long $\times$ 3–4 mm wide, tomentose on the abaxial surface with small or large 5–8-rayed stellate hairs 0.3 mm or 1.5 mm diam, ca. 1/3 of the hairs with



2–4 enlarged and thickened rays apically directed, adaxial surface of lobes pubescent with downy minute simple hairs medially and with minute stellate hairs towards the margins; *corolla* yellow, petals asymmetrically bilobed, (6) 8–10 (12) mm long $\times$ (3.5) 4–5 mm wide slightly exceeding calyx by 2 mm, campanulate at anthesis and not spreading, claws pubescent at base with coarse stellate hairs; *androecium* with (26) 35–36 (70) stamens, filament tube 2–2.5 mm long, pubescent with coarse 5–6-rayed stellate hairs, free portion of filaments (0.5) 1 mm long, anthers 0.5 mm long after dehiscence; *gynoecium* with (11) 14–15 (16) loosely coherent carpels, style branching 2 mm above the columella, each branch terminated by a globose expanded stigma raised above the anthers by 0.5 mm not recurved at flower wilt, ovary surface densely pubescent with centrally directed simple appressed hairs; *schizocarps* 9–11 mm diam including ornamentation; *mericarps* (11) 13–15 (16), 3.0–4.5 mm in height $\times$ (3) 4–5 mm in length $\times$ 2 mm in width including ornamentation with a proximal-apical cusp 0.1–1 mm long and 2 distal-apical cusps 0.5–1 mm long, the latter distinctly separate but curved towards one another, lateral faces with conspicuously opaque ribs extending into a thin translucent winged border extending 0.5 mm from the mericarp body, distal surface with a conspicuous raised medial line, vesture restricted to the apical surface of coarse strigose rigid proximally directed appressed simple hairs 0.8 mm long, proximal-apical region thin solid woody, completely indehiscent, endoglossum absent, readily separating from the receptacle at maturity; *seeds* slightly narrowed in the basal half below the hilum, 2.5 mm in height $\times$ 2 mm in length $\times$ 0.7 mm in width, seed coat dark brown; *chromosome number*: $2n = 24$; *pollen* 62–79 (70) μm diam, echinae 4–5.1 μm , apertures 15–30.

Figure 58. *Malvastrum amblyphyllum*. a. Habit, scale = 5 cm. b. Petal, scale = 2 mm. c. Stamens, styles, and stigmas, scale = 2 mm. d.–f. Mericarp, lateral, distal, and apical views, scale = 1 mm. g. Mericarp, internal view, scale = 1 mm. h. Fruit, apical view, scale = 2 mm. i. Seed, scale = 1 mm. j. Calyx in fruit, vesture not indicated, scale = 2 mm. k. Columella and carpocrater, scale = 0.5 mm. l. Stipule, scale = 1 mm. m. Bracteole, scale = 1 mm. n. Leaf, scale = 2 cm. o. Cotyledon, scale = 5 mm. p. Calyx vesture, scale = 0.5 mm. q. Leaf vesture, adaxial surface, scale = 0.5 mm. (All drawn from progeny of *Krapovickas et al.* 18558).



DISTRIBUTION. (Fig. 57) Restricted to the Chaco region of southeastern Bolivia, central and northern Paraguay, and northwestern Argentina, at elevations of 100–1000 m.

PHENOLOGY AND REPRODUCTIVE BIOLOGY. Flowering February–June (summer–autumn where native). In cultivation in Texas seeds of *Krapovickas et al.* 18558 germinated after four days and first flowered in October and November (local autumn) after 120 days of growth. The flowers were produced for less than 30 days, each lasting a single day and open for two hours (10:30–12:30 CST, opening one hour earlier on warmer days, the variables apparently being light intensity and temperature). Under cultivation the flowers always self-pollinated, the pollen usually being released directly onto the stigmas. Self-pollination is also likely the predominant means of reproduction in wild populations even with insect visitors due to the close proximity of the anthers and stigmas and the brief flowering time. Fruits ripened in 29–33 days after anthesis. The seeds are viable for at least 7 years.

DISCUSSION. Fries was the first to note the unusual features of this species. Hassler chose to describe the plant as *Malvastrum scabrum* var. *tucumanense*, and a non-fruiting specimen was called var. *paraguariense*. *Malvastrum amblyphyllum* is distantly allied (along with *M. grandiflorum*) to *M. tomentosum*. *Malvastrum amblyphyllum* probably had a progenitor similar to *M. grandiflorum* but developed along a reductional pathway, becoming an autogamous species. Its greater range demonstrates its degree of success with this mechanism. Despite autogamy, the species is diverse with respect to stamen number and inflorescence density but the latter character seems to be correlated with plant maturity.

SPECIMENS EXAMINED. **Paraguay.** CONCEPCIÓN: fields, hillsides, San Salvador, *Rojas* 2602 (G, pf); Saavedra, Chaco Paraguayo sandy soil, *Rojas* 7041 (G); ASUNCIÓN: low hills, Luque, *Rojas* 1685 (G, pf); río Apa, *Hassler* 21 (G); Pycuiba, *Rojas* 7278 (BH, G); San Salvador, *Balansa* 1624 (BH, G). **Bolivia.** SANTA CRUZ: Río Parapetí, *Krapovickas* 9482 (TEX); Cordillera, 22 km N of Gutiérrez, *Krapovickas & Schinini* 31452 (G); 4 km S of Roboré, *Krapovickas & Schinini* 36499 (MICH, srh); Santiago, *Krapovickas & Schinini* 36470 (srh); TARIJA: Bajada de San Simón, 15 km E of Entre Ríos, Tarija-Villa Montes road, *Krapovickas* 19127 (pf); CHUQUISACA:

Figure 59. *Malvastrum amblyphyllum* (holotype).

prov. Azero, 5 km N of Carandaytí, *Krapovickas & Schinini 31229* (MICH); Tapirendita, 15 km E of Villa Montes, *Krapovickas et al. 19336* (TEX, UC). **Argentina.** JUJUY: San Pedro de Jujuy, railroad right-of-way, *Krapovickas 4765* (DAO); SALTA: Dpto. Metán, río Juramento, ruta no. 34, *Krapovickas et al. 18558* (pf, TEX, UC, WIS); Dpto. Metán, Esteco, roadside, *Krapovickas et al. 27984* (G, MO, UC); Dpto. Orán, Padre Lozano railway station, *Krapovickas 1322* (NY); Dpto. Gral. S. Martín, Campo Durán, *Krapovickas et al. 19494* (pf); 0–3 km west of Cabeza del Buey, road to Salta, *Krapovickas 7246* (WIS); TUCUMÁN: Burruyacú, Cañada Alegre, *Gonzalez 19935a* (G).

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